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DATED Sept 22nd 1975

THE UNIVERSITY OF ALBERTA

THE RECREATIONAL USE OF THE HYDRO-ELECTRIC POWER RESERVOIRS OF ALBERTA

by

© RICHARD WILLIAM BENFIELD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS.

DEPARTMENT OF GEOGRAPHY

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FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE RECREATIONAL USE OF THE HYDRO-ELECTRIC POWER RESERVOIRS OF ALBERTA submitted by RICHARD WILLIAM BENFIELD in partial fulfilment of the requirements for the degree of Master of ARTS.

Date Sept. 22, 1975

ABSTRACT

Demands are rapidly increasing for the use of the natural resources of Alberta. Included in these demands are those for greater recreational use, especially in the mountain and foothill regions. This study is an attempt to investigate the possibilities of providing additional and more varied recreational opportunities on or near the hydro-electric power reservoirs of Alberta where present use is relatively limited. The allocation of areas such as these to recreational use is desirable but the needs of other resource users must also be met, hence the study is an exercise in multiple land and water use planning.

Firstly the study includes a review of the present patterns of recreational use with particular emphasis on the patterns of use at the hydrc-electric power reservoirs of Alberta. These patterns are then compared with patterns of recreaticnal use of reservoirs elsewhere to provide a perspective on the problem. The physical geography of the regions in which the reservoirs are found is then discussed. In particular, physiography, climate, vegetation, soils, water and wildlife patterns are reviewed and the effects of each upcn resource use is indicated. The recreational capability of the reservoirs is estimated through the use of

the Canada Land Inventory classification for Outdoor Recreaticn. The discussion of the recreational capability is then broadened to include other factors which could influence recreational use. These include considerations of access, current facilities and other land uses. Management history and practice are also reviewed for management issues has greatly influenced resource development in the mountains and foothills of Alberta. Various alternative courses of action to provide for greater recreation opportunities are then suggested. To aid in this, a resource compatibility matrix is derived to see where conflicts between land uses will arise when resource allocations are made. In addition, a classification of the components of recreational use of reservoirs is provided to serve as a framework for the particular development proposals.

The conclusion is that greater recreational use of the hydro-electric power reservoirs is possible but such use is hampered by single-use and single-means planning and development of the resources. Furthermore there is a lack of Government initiative to implement the measures outlined. As a result, there is under use of the recreational resources present. In addition, it is concluded that there is a need for further research into resource allocation to ensure that

the resources are used more effectively in meeting public needs.

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INTRODUCTION

For many years the mountains and foothills of Alberta have been used for a diversity of purposes. Recreation was one such use and in the national parks it often had an exclusive and dominant position. In contrast, recreation was left to compete with other land uses in the eastern slopes outside national park boundaries. As a result recreation in the eastern slopes of Alberta was relegated to a role subsidiary to revenue-producing land uses such as hydro-electric power, mining, forestry and commercial grazing. Today, demand for recreation is becoming increasingly important. Thus recreation should be given more attention in land use planning in western Alberta, particularly when the recreational resources present are considered unique in a global sense. It is the author's purpose in this thesis to examine the potential use of hydro-electric power reservoirs for water-based recreation - one particular situation where recreation may be more fully developed.

In the planning of water resource utilisation for more than one purpose (eg. hydro-electric power generation and outdoor recreation) the problem of compatibility of resource uses will arise. Furthermore this problem is compounded by

demands placed on the area by other resource uses such as forestry, mining and watershed management, thus, this study is an attempt to study hydro-electric power reservoirs in terms of their potential for recreational use as well as other uses and to make recommendations where it is deemed advisable.

RELEVANCE OF THE RESEARCH TO GEOGRAPHY.

> Space, spatial relations and change in space - how physical space is structured, how men relate through space, how man has organised his society in space, and how our conception and use of space change - are core elements of the science of geography.
>
> Morrill (1970 p. 3)

In this study of outdoor recreation at hydro-electric power reservoirs, all of the dimensions of geography expressed by Morrill are represented. The structure of physical space will be examined under the physiography, climate, flora and fauna of the study area. Spatial relations and organisation are examined through the needs in recreation, present land uses and the management of the study area. Spatial change and concept of space is included in the discussion of the development of land use and the capability of the reservoirs to support recreation. Hence a study of recreational use of reservoirs is valid geographical research.

In addition, in attempting to accommodate recreation at the hydro-electric power reservoirs of Alberta, great emphasis is placed on the need for planning. Mcloughlin (1969) has defined planning as "the control of change in a system, the system being composed of those human activities and communications which have a locational or spatial element". Therefore planning has a justifiable role in a geographical study of reservoir recreation. The result of this focus is that the research has value as a pure research study in providing spatial data and also as a contributor towards applied studies in recreation geography.

OBJECTIVES AND PROCEDURES.

The objective in this thesis is to provide a contribution towards the formulation of a management plan for the hydro-electric power reservoirs of Alberta. In particular the potential for recreational use of the reservoirs and their shorelands is assessed.

Mcloughlin (1969) recognises the planning process as being a five-stage cycle. These stages are:

1. The environment is scanned and needs or wants are identified.

2. Goals are formulated and more precise objectives are identified.

3. Possible courses of action to reach the objectives and move toward the goals are examined. To generate

possible courses of action a model of the system is required.

4. These courses of action are evaluated in terms of means available, costs, benefits and consequences.

5. A program is effectuated, it being the best of the possible courses of action.

As the change is made so new goals and objectives become apparent and hence the cycle begins again.

(Mcloughlin 1969 p.95)

In this thesis only the first three stages are examined in depth. In chapter two the needs and wants in recreation are identified. In chapter three a literature review is conducted on recreational use of reservoirs to put the needs and wants for recreation into a more complete perspective and upon which to base future resource allocation. In chapters four, five and six, the environment is evaluated to provide a data base upon which planning can be formulated. These chapters are concerned with the physical resources, the recreational capability and other land use variables, all of which set substantial constraints on the development potential and the prospects for development of the reservoir areas. In chapter seven the goals and objectives for recreation at the reservoirs are formally stated. They are developed on the basis of the preceding sets of data. From this statement possible alternative courses of action are outlined. To aid in this process a classification of

reservoirs is derived. Possible management alternatives are also presented. In the conclusion of the thesis, further needs and wants in regard to multiple land-use options are identified.

FIELD APPROACH.

An inventory was conducted in July and August of 1974 to ascertain the physical resources of the area, the recreational facilities present, and the recreational capability of the reservoirs. Prior to this a general literature review on reservoirs had been conducted, maps and air photographs of the area had been studied and detailed literature and statistics on the reservoirs had been acquired. Throughout the period of study informal interviews were conducted with people concerned with the topic under study. These people included officials of Calgary Power Company (the reservoir owners), officials of the government departments which have jurisdiction over the study area and recreationists who use the area.

THE STUDY AREA.

There are thirteen hydro-electric power sites in Alberta but only nine have significant separate storage. It is these nine sites that will receive major consideration.

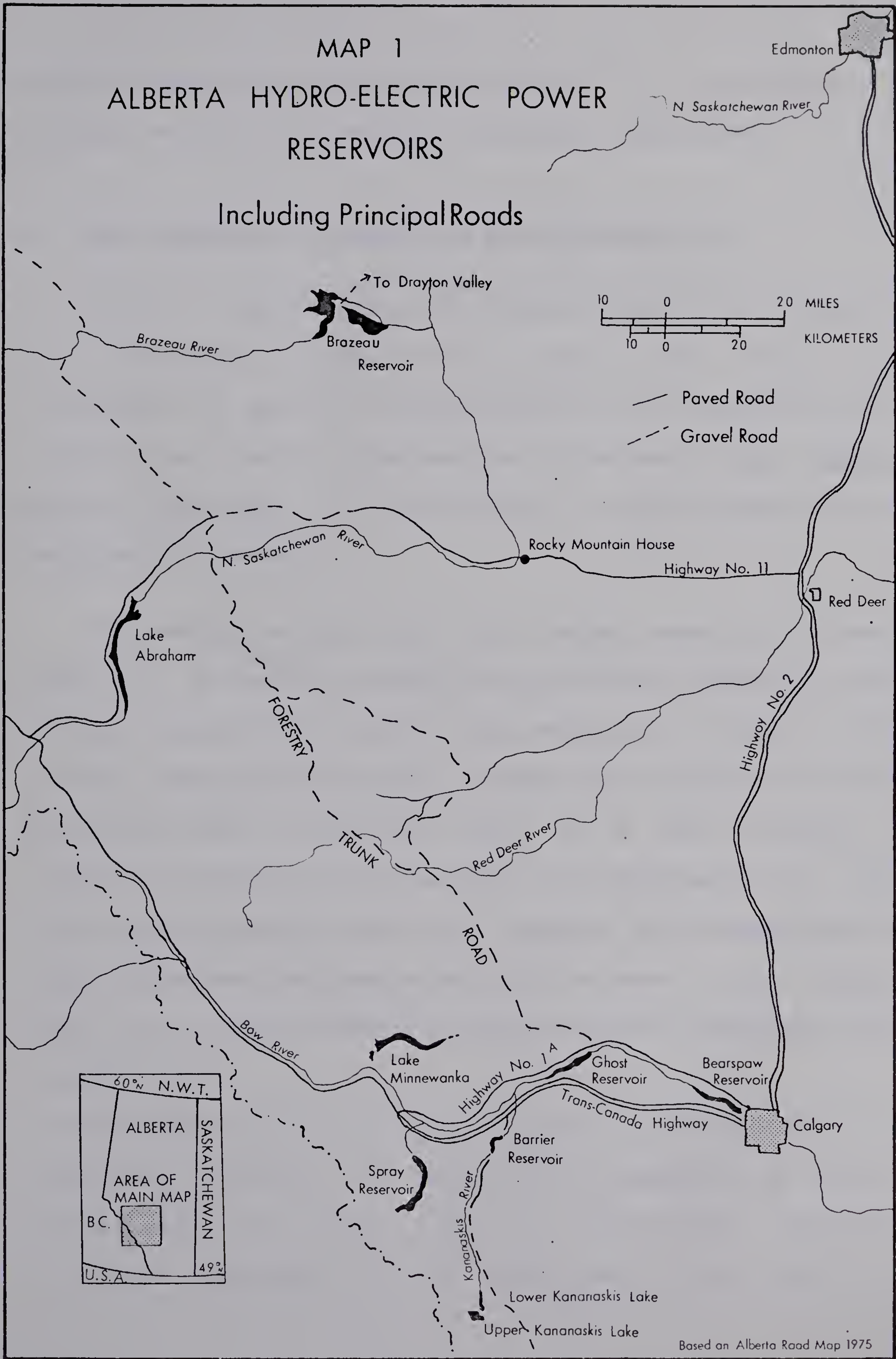
Seven are in the Bow River System and two are on the North Saskatchewan System. The nine reservoirs are as follows:

Bow System	Bearspaw Reservoir
	Ghost Reservoir
	Lake Minnewanka
	Spray Reservoir
	Upper Kananaskis Lake
	Lower Kananaskis Lake
	Barrier Reservoir
North Saskatchewan System	
	Brazeau Reservoir
	Lake Abraham (Big Horn Reservoir)

In Map one the location of the reservoirs within Alberta is indicated.

All of the sites are in the mountain and foothill areas of Alberta. Other sites in these areas and in the plains have been and are being considered for hydro-electric power and multiple use development. These development areas will be noted and, in addition, power demand related to thermal developments will be noted for this will affect future hydro-electric power reservoir use and development.

In any study of recreational use of reservoirs the surrounding land must be examined for its inherent land use qualities and for the jurisdictional arrangements that exist for its management. As a result, when reference is made to "the study area" all the area demarcated in Map one is used. This area includes all of Banff National Park, the eastern slopes as defined by the Environmental Conservation Authority of Alberta, and the land around Bearspaw and


MAP 1
ALBERTA HYDRO-ELECTRIC POWER
RESERVOIRS
Including Principal Roads
Edmonton
N Saskatchewan River
To Drayton Valley
Brazeau River
Brazeau
Reservoir
10 0 20 MILES
10 0 20 KILOMETERS
Paved Road
Gravel Road
Rocky Mountain House
N. Saskatchewan River
Highway No. 11
Red Deer
Lake
Abraham
FORESTRY
TRUNK
ROAD
Red Deer River
Highway No. 2
Bow River
Lake
Minnewanka
Highway No. 1A
Ghost
Reservoir
Bearspaw
Reservoir
Trans-Canada Highway
Calgary
Barrier
Reservoir
Spray
Reservoir
Kananaskis River
Lower Kananaskis Lake
Upper Kananaskis Lake
60°N N.W.T.
ALBERTA
SASKATCHEWAN
AREA OF
MAIN MAP
B.C.
U.S.A.
49°N
Based on Alberta Road Map 1975

Brazeau Reservoirs respectively under the jurisdiction of Calgary and Red Deer Regional Planning Commissions.

E. THE CONCEPTS OF RECREATION AND MULTIPLE USE.

Before investigating the present demand for recreation it is necessary to define what is meant in the thesis when reference is made to recreation and its integration into multiple use planning. Recreation is defined in The Concise Oxford Dictionary as "refreshment, entertainment or the amusement of oneself".

Recreation workers have been more specific. Clawson (1966 p. 6) defines recreation as "not the activity itself but the attitude with which it is undertaken" Patmore (1970 p. 225), being more specific, states that recreation is "the positive use of leisure spent in a wide variety of pursuits." Although there has been much discussion on what constitutes positive use of leisure, this definition has found widespread acceptance and will be used in the thesis. Using this basic definition various other recreation terms can be defined.

A "recreationist" is one who actively participates in a recreation activity. A "tourist" is thought of as being a recreationist who visits a resort. Recreational Resources are those features of the environment upon which the

recreationist will act upon or respond to.
The recreational capability of the area is an index of the interaction between the physical recreational resources present at a recreation area and their suitability to accommodate various recreational activity preferences. (See Glossary)

"Multiple use management" is the implementation of policy measures to reach optimum use of natural resources for a variety of land uses. Outdoor recreation is one such possible use.

The concept of multiple use management was originally applied to forested lands in which certain tracts of land were used for different purposes. Each use was confined to a certain designated area and, with careful planning, harmony in different land uses could be attained. This concept was subsequently extended to the situation where a certain tract of land was used for two or more purposes either at different times or simultaneously: this latter interpretation of multiple use is used in the thesis.

Clawson (1966 p.161) points out that the economic rationale for multiple use is "that the sum total of the values thus created is greater than the value from any single use - and enough greater to more than offset the added costs." Jeffrey (1969 p.7) believes that multiple use

is a social concept and suggests that it is "the achievement of maximum output from the optimised use of natural resources of a specific area for the benefit of a referent group and its successors." Inherent in either belief is the recognition of other interests apart from the land use originally designated for the area. In order to apply multiple use, Jeffrey suggests that three aspects of management should be defined: the definition of management areas; the establishment of referent-group needs and management policies to allow adequate planning and practical application of the concept.

Chapter 2

THE DEMAND FOR OUTDOOR RECREATION

The demands for outdoor recreation space have been growing at an unprecedented rate in recent years. This trend has been well documented in the geographical literature. To understand how much and in what form the demand is expressed, we must examine the factors that cause this demand and hence translate this into the type and amount of recreation space and resources that will be needed to satisfy this demand. After a general study of the type and amount of recreational space and resources needed, the situation as it exists in Alberta will be examined. This will be dependant on the demand factors as they exist in the province. The patterns of recreational use at the hydro-electric power reservoirs of Alberta will then be examined to indicate their possible use as areas for alleviating recreation demand.

The factors that determine the rise in participation in outdoor recreation have been summarised by Brooks (1961 p.957). He suggests there are three.

1. The population factor.
2. Increased available time and income.
3. The influence of technology.

The first factor, population, in its numbers, composition and distribution is perhaps the most fundamental factor to be considered in the evaluation of the demand for land for outdoor recreation. In essence the population pattern is one of great growth while at the same time the median age of this population has been falling. (Statistics Canada, 1974) Accordingly since most recreation activities have been observed to be more actively pursued by persons under 30 years of age a younger growing population is dictating the increase in recreation participation (Brooks 1961 p.959). Furthermore the trend towards urbanisation gives an important spatial dimension marked by concentration in a few selected areas.

Secondly several socio-economic factors which are important determinants of the degree of outdoor recreation participation are also observed to be changing. Among these factors, two which seem to stand out as especially significant are the increase in leisure time and the increase in real per capita income. In the former the observed trend has been toward a general shortening of the work week and, as the hours of sleeping, eating and personal hygiene remain relatively constant, it is reasonable to assume that much of the increased free time has been utilised by pursuing more leisure activities. With regard to

per capita income, Clawson (1960 p.135) has pointed out how real incomes have risen in North America but what is more significant is that consequent with this growth has been a parallel per capita rise of expenditure on recreation and this may well be more than proportional to the rise in incomes.

Thirdly and closely associated with the above trends has been an increase in technology. General increases in technology have permitted the above trends but the most positive feature influencing the demand for recreation has been the dramatic increase in personal mobility. Total travel per capita has increased greatly with the phenomenal growth of motor travel. Brooks (1961 p.962) quotes the situation where in Canada in 1900 there were only a handful of cars while sixty years later over 3.5 million cars were on the roads. The total of motor vehicles in Canada had increased to over 9 million in 1974. Brooks further estimated that close to 90 percent of all recreational travel in North America is now by personal automobile while the other ten per cent would be accounted for by the rapid rise in air travel.

TYPES OF RECREATIONAL AREAS NEEDED TO MEET FUTURE RECREATION DEMANDS

Clawson (1960 p.136) in an attempt to devise a simple

classification upon which to evaluate land needs for outdoor recreation, separated recreation areas by type and location into three divisions - the resource based, the user oriented and the intermediate use areas. The resource based outdoor recreation areas are those of such unusual quality that people are willing to travel considerable distances to visit them. They would include national parks, national forests and the federal wildlife refuges. They are the largest of the three in total area, smallest in total amount of use and hence lowest in overall intensity of use. However these averages conceal great variation in intensity of use. The most popular places within some national parks have annual visits running up to several thousand people per acre - witness the visitation of 2,300,000 people to Banff townsite in 1970 while thousands of acres of remote country in the Park are visited by only a very few people in total (Bryan 1973 p.262). Overall, however, resource based recreation areas are experiencing a rapid increase in usage and the brunt of this is falling on selected areas. Unfortunately the historical process that has provided for publicly owned resource based areas can now be seen to be complete; the supply of high calibre sites that have not already been incorporated into public recreation areas is running low. There is a finite supply of such natural areas available and the problems and difficulties of acquisition of land for

such areas is becoming more acute. The problem becomes one of carefully planning land within the resource based areas for both intensive demand and for activities that do not require such intensive use of recreational resources. This idea of allocating resource based recreation land in response to demand and not physical characteristics is a new approach but only by using this approach can there be efficient and optimal use of recreational land. As an example the characteristics of resource-based recreation land can be readily identified in the study area: Spray Reservoir and Kananaskis Lakes have the physical characteristics to be classified as resource-based recreation land. However use of these areas has been low because of limited physical access to the areas and their proximity to Banff National Park. In addition Lake Minnewanka can be regarded as being located in a typical resource-based area. Furthermore its proximity to Banff townsite results in it having a high intensity of recreational pressure but its area and length also permits it to have other land used for low intensity recreational purposes. Thus land use planning on this reservoir spans the problem of differing densities of use on resource based land. The area around Lake Abraham is also theoretically resource based; however, again recognition of the qualities of this site has been slow owing to access problems and the

proximity to Banff National Park. The tourist, which is the typical type of recreationist visiting resource based areas has been slow to use the Lake Abraham area. The problems of resource based recreation land are problems that are limited to this type of land. Managers of these areas must cope with the problem of having large tracts of land which undergo little recreational use, but in which facilities must be provided, while at the same time having small areas of extremely high density use. Thus reservoir development in or close to such areas could have a significant impact on the quality, quantity and location of recreational opportunities available in these resource-based areas.

At the other end of the recreational land spectrum there are the areas Clawson called "user-oriented areas." These include municipal and county parks and are needed to cope with the immediate recreational demand of an urban population. In Alberta Bearspaw Reservoir is undergoing pressure from suburban subdivision of the shoreland and future urban growth is likely in the Canmore Corridor. Recreation policies for these areas need to reflect such demand patterns.

The "intermediate-use areas" lie between resource-based areas and the user-oriented areas. They are primarily places for day outings and are usually located within two hours

driving time from urban centres. They usually include provincial parks, hunting and fishing areas and in particular reservoirs of various ownership and function. In Alberta these areas would be represented by Ghost Reservoir, Kananaskis Lakes, Spray Reservoir, Brazeau Reservoir and Lake Minnewanka. All of these hydro-electric power reservoirs lie in the day-use recreation zone of the urban centres of Alberta.

In the United States it is found that such areas are intermediate in total area, total use and intensity of use per unit area yet they have experienced the highest rate of growth of use of all three areas, probably due to the mobility factor which is most pronounced near urban areas. Slightly over 15 million acres were reported in U.S. Corps of Engineers, Tennessee Valley Authority and Bureau of Reclamation reservoirs in the U.S.A. in 1969 but this acreage is unevenly distributed throughout the U.S.A.; moreover there exist no standards by which to measure the adequacy of the provision of such recreational areas. Clawson (1960 p.137) suggests that a satisfactory standard would be the provision of one or more intermediate recreation areas within two hours driving time for 90 per cent of the total population. The thinking behind this standard is the belief that as such areas are primarily places for day outings, two hours driving (or approximately

100 miles) seems the maximum distance a driver would consider undertaking before the distance becomes too large for a satisfactory and enjoyable recreation experience. Given the total area of this recreation space it seems that especially in their more popular places, intermediate use recreation areas will undergo usage which is comparable in density to that of a municipal area. The annual rate of visitor increase to intermediate use areas is around 10 per cent in the U.S.A. (1969). Of particular interest in this area has been the growth in the demand for water-oriented recreation land. As an example the annual rate of increased use on reservoirs in the U.S. has fluctuated between 15 per cent and 28 per cent in recent years, while paralleling this has been an increasing capital expenditure on boats and water-based recreational sports and activities. By their very nature these aquatic activities often require similar facilities so that conjestion and conflict are increasingly taking place. In addition Johnson and Tyrell (1961 p.1009) point out the problems of acquiring water-oriented land areas for recreation. To these researchers the problems of continuing to provide adequate areas for this type of demand seem more urgent than in any other field of outdoor recreation. Indeed Clawson states:

> "The major present problems of the intermediate type of outdoor recreation can be briefly listed: for the state parks inadequate total area, insufficient numbers...in needed

> lccations; for the reservoirs location according to hydrology rather than recreation is a limitation...and as a system there has been inadequate provision for future demands that the future will certainly bring."
>
> (Clawson. 1960 p.182)

Having identified the types of land needed for outdoor recreaticn, demand studies in Alberta can now be compared with the current use patterns at the hydro-electric power reservoirs and hence indicate what recreation needs the reservoirs could possibly fulfill.

DEMAND FACTORS FOR OUTDOOR RECREATION IN ALBERTA.

Within Alberta the factors causing the growth in demand for outdoor recreation are very much the same as those outlined above (Dooling 1967 p.91). This is traceable in statistics. With regard to population the population of the Prairie Provinces in 1971 was 3,542,363 and it is estimated that this will rise to 4,000,000 by 1981 (Statistics Canada 1973). These people are presumed to represent the most immediate recreation demand area. Of this total, Alberta contains 45% of the Prairie Provinces population, or a population of 1,627,874 (1971). It is estimated that the Prairie Provinces will have a population of 1,851,959 in 1980 and 2,143,662 in 1990. More particularly it has been estimated that the populations of Calgary and Edmonton will have increased from 403,319 and 495,702 respectively in 1971

to 550,000 and 672,000 respectively in 1981 (George 1972 p.23). Although not so spectacular, smaller population centres such as Medicine Hat, Red Deer and Lethbridge are also expected to experience high growth rates which will also add to the growing demands for recreation facilities especially in the intermediate-use zone around the main centres. This is in keeping with national trends, since 90% of the Prairie Provinces are expected to be urbanised by 1990 with Calgary and Edmonton continuing the main urban centres in Alberta (Statistics Canada 1971 p.208).

With regard to income, per capita income rose by 12.5 per cent in 1971-72 in Alberta, a rate above the national average of 10.7 percent, while there was a 56% rise in automobile ownership in the ten years from 1961 to 1971, from 509,298 cars to 813,395 cars (Statistics Canada 1971 p.647).

The recreation participation of Albertan residents has been more closely defined in a study by Ben Crow and associates (1968). In a household study on the habits and preferences of Canadians for leisure time activities the comparative participation rates among the population for various outdoor recreational activities were shown. The study showed that participation rates for the average prairie resident is generally higher than the national

average. Furthermore the study revealed that the growth rate of prairie participation is the most active in the country with the Calgary-Edmonton axis leading within the prairie region. In terms of the recreation activities pursued by Canadians, the study showed some deviation of prairie participation from the national average. Pleasure driving, picnicking and sightseeing were the most popular pursuits and these were sought after in much the same intensity across the country. Unfortunately the quality and quantity of the existing recreation opportunities were not investigated. Activities of a more intensive nature such as swimming, power boating, camping, fishing and hunting were also highly in demand but for swimming and power boating the proportions of participants indulging in these activities in the prairie provinces, 42% and 12% respectively, were below the national average of 55% and 17% respectively. This suggests a potential unfulfilled demand for water-based recreational opportunities that must be considered when designating prairie and mountain areas for future water-based recreation use.

The survey also pointed out the popularity of motoring in the Prairie Provinces. This is exclusively pleasure motoring and may well indicate the response of a highly mobile population to a readily available supply of high quality viewing sites. If this is so, access by automobiles

to potential water-based recreation areas, such as hydro-electric power reservoirs, becomes an important development variable.

It is also worth noting that picnicking is very important to the prairie resident with the highest percentage of participation in Canada being found here. This highlights the importance of intermediate use vacation trips. In total these figures, indicate some major differences in activity participation by prairie recreationists. Furthermore they suggest that some problems in the provision of recreational facilities to satisfy recreation demand may be peculiar to the particular area under study.

Few statistics are available on the trends of participation in various outdoor recreational activities in Alberta or Canada owing to the relative recency of the acceptance of recreation as a valid area of academic and government study. However, United States statistics on trends in activity participation can be used as indicators of possible Canadian trends. The Bureau of Outdoor Recreation, Dept. of the Interior in a study "Outdoor Recreation Trends" in 1967 estimated participation in water ski-ing would increase 121% between 1965 and 1980, camping 78%, hiking 78%, and swimming 72%. By the year 2000

participation in water ski-ing is expected to have increased by 363%, camping 238%, hiking 218%, boating 215% and swimming 207%.

Whatever the precise future growth in recreation participation it seems that the factors governing recreational development are unlikely to change and that the annual growth rate in recreational participation of 10% over the last ten years will either be maintained or exceeded.

PATTERNS OF RECREATIONAL USE AT THE HYDRO-ELECTRIC POWER RESERVOIRS OF ALBERTA

There is little comprehensive information presently available concerning the use characteristics at the individual hydro-electric power reservoirs of Alberta. Those studies that do exist indicate that many of the general prospects and trends outlined above are indicated in superficial studies of the hydro-electric power reservoirs.

No recreation surveys have been located for Bearspaw Reservoir, even though subdivision is occurring on the north and south shore. On the north shore 84 houses are planned and on the south shore 54 acres have been subdivided. The subdivision is an attempt to meet the needs of suburban expansion of Calgary. Recreational use of the reservoir for boating is present, particularly on weekends, but the

subdivision could limit access to the water in the future.

At Ghost Reservoir the only data that exist are for a summer cottage development (70 cottages) on the north shore. All but one of the cottage owners are from Calgary. It is assumed that those water-based recreationists who were observed during field study are from the cottages. This is because access is difficult for non-resident recreationists.

At Barrier Reservoir no recreation activities were observed but it is known that the surrounding upland is used by hikers. A traffic count on the adjoining Forestry Trunk Road showed an average of 312 cars per day using the road during the summer of 1974. Part of this total could include recreationists enroute to Kananaskis Lakes or in the area for scenic viewing.

More data exist for the Kananaskis Lakes, due mainly to the work of Rump (1967 pp.55-73). He traced the origin of cottage site visitors as being 94 per cent Calgary based, but only 69 per cent of the visitors at the campsite were from Calgary. Furthermore he established that a recreationist at Kananaskis Lakes comes mainly for fishing (17% of the visitors), boating (15%), nature appreciation (9%), relaxation (13%), hiking (10%) and riding (10%). The campsite visitor tends to stay either one day or two days and rarely longer. The weekend is the most popular time for

the visit. Rump did not ascertain the numbers of recreationists but a count by the writer on a holiday weekend in July 1974 indicated a total number of camper units in excess of 75. At that time all the official camping space was taken and other unofficial sites were being used. Rump also determined that the Kananaskis Lakes area was the destination for the majority (78%) of visitors rather than being a point visited while in transit (Plate 1).

At Spray Reservoir less information is available. A creel count of fishermen (the predominant recreationist) in 1962 on one day in July indicated twenty-one anglers, each staying approximately six hours on the reservoir. Other studies in 1953, 1954 and 1955 indicated a comparable average of 25 anglers per day staying six hours each. Observation by the writer suggested that this average still held. The majority of those anglers were also campers. A count of camper units in August 1974 gave a total number in excess of 40. Again that is a total that far exceeds the capacity of the existing official campsites. Like Kananaskis Lake unofficial campsites have been developed and damage to the environment is occurring. Visitor origin data indicated a majority (53%) are Calgary based recreationists while a similarly high percentage were also local visitors (24%) and from other parts of Alberta (22%).

For Lake Minnewanka much more detailed statistics exist on which resource allocation or planning might be based. On the basis of the available statistics, a convenient two-fold division of visitors can be made-those at the reservoir itself which constitutes a day-use zone, and those at the campground to the west of the power canal which is a zone with more variable visitor characteristics. At the parking lot at Lake Minnewanka, 74 per cent of the vehicles were registered in Alberta. This is an index of the heavy regional use of the Lake Minnewanka area for day-use activities. From numbers of vehicles mid-afternoon was seen as the most popular time to visit while weekends were the periods of heaviest use. The average number of cars recorded in the parking lot on Sunday at 1:00p.m. was 146. At that time car number exceeded the capacity of the parking area (145 cars). Seasonal average daily traffic in 1971 was 1550 cars going to Lake Minnewnaka. The effect of this large influx of recreationists is very local however, for parking lot use decreases as one moves away from the boating area (Map 19). The trail that goes northward from the furthest lot has low use when compared to use in the boating area. No data exist on the use of the picnic, boating and trail facilities but it is suspected that Albertans are the main users. In contrast the scenic cruise seems to attract more tourists.

For the campgrounds it was found (National and Historic Parks Branch unpublished) that the majority of recreationists were from the United States (42%), with Alberta (34%) following and then the remainder of Canada (24%). These statistics reflect the international tourist role of Banff National Park. They represented 27,551 people in 1970, 30,958 in 1971, 28,372 in 1973 and 28,811 in 1974. The maximum capacity of the campsites was exceeded on 31 nights in 1971. No data exist for the other years. Overall these figures indicate a dual nature for Lake Minnewanka - that of a site of international significance and yet also a site of high local and regional use.

For Brazeau Reservoir there exist no data on recreational use. Estimates by the writer would suggest a maximum of 75 visitors on an average weekend, drawn mainly from the local rural hinterland and Drayton Valley. The major recreation activity is fishing but boating and camping are also important activities (Plate 2).

At Lake Abraham data exist on visitation to the one recreation complex present. The campsite has been used by 621 campers in two years of operation. The majority (80%) were estimated to be from Edmonton, Calgary or Red Deer. The motel had 183 visitors in 1973 and 1584 in 1974. In a random sample 21 percent were found to come from Edmonton, twelve

percent from Calgary, nine percent from Red Deer, thirteen percent from Central Alberta excluding Red Deer, twelve percent from the rest of Alberta, 24 percent from other Canadian provinces and seven percent were foreign. The duration of stay of the visitors was highly variable. A traffic count in 1973 on the adjacent road showed an average for the year of 290 cars per day (both ways), with an average summer daily count of 355. Overall the figures indicate that this is a low use recreation area (See Appendices).

From all of the above statistics it can be seen that the greatest recreational pressure on the hydro-electric power reservoirs of Alberta will come from demand for day-use activities. Certainly some reservoirs have locations in or just outside a national park that has an established national and international reputation and which attracts visitors for a once in a lifetime trip or extended holiday. Nevertheless the greatest pressure seems to come from the recreationist from within 100 miles or two hours driving time from the large Albertan metropolitan centres. This would indicate that the most pressure will be found on hydro-electric power reservoirs on the Bow River system rather than the hydro-electric power reservoirs on the North Saskatchewan System.

From the recreational use patterns identified, it can be seen that many of the land and water-based recreation facilities have in some instances under present management conditions reached a point of optimum or over-use. However potential recreation demand seems unfulfilled. The hydro-electric power reservoirs of Alberta offer interesting prospects for meeting more of this demand but only if the physical potential and capability exists and the management and development schemes are effectively co-ordinated with other resource needs.

Chapter 3

A REVIEW OF SELECTED LITERATURE ON MULTIPLE USE OF RESERVOIRS

In this chapter it is proposed that some of the literature that has been produced on multiple use of reservoirs will be examined. This will be done to provide a more complete perspective on the problems and possibilities at Alberta hydro-electric power reservoirs and to get a broader based rationale for the allocation of Alberta's physical resources than was possible in the preceding problem statements in chapters one and two. To this end the chapter has been systematically divided into six sections: the first section is devoted to the history of multi-purpose development and management cf reservoirs and adjoining lands. The second section is an investigation of literature on the benefits of including recreation in multi-purpose reservoir projects. These benefits have been mainly measured in economic terms but there is a need for recognition of intangible benefits as well. The third section is a brief indication of some of the inventories undertaken to ascertain resources, capabilities and facilities for recreation at reservoirs. The fourth section is devoted to

work produced on multi-purpose reservoir operation and the problems that have arisen when this is attempted. The fifth section is a brief indication of solutions that have been proposed to alleviate such problems and finally the sixth section is a look at regional approaches to water management in order to gain insight into the problems outlined earlier and to indicate possible Albertan approaches to water management.

The literature for this review is compiled from academic journals, consultants reports and from government reports and documents most of which are specific to particular areas. There are also several excellent bibliographies on water resources and management that include references that may be used for more detailed analysis.

The History of Multi-purpose Development and Management of Reservoirs and Adjoining Lands.

Multipurpose reservoir operation has been longest in operation in the United States, although with varying degrees of intensity. The Tennessee Valley Authority (T.V.A.) reservoirs built in the 1930's were the earliest examples in which a water management authority practised integrated resource management. Using this approach, a remarkable supply of recreational opportunities have been

provided over the years since the initiation of this policy. Many other projects came to be multi-purpose in nature. Significant among these are reservoirs built by the U.S. Bureau of Reclamation particularly Lake Mead formed in 1938, and reservoirs built by the U.S. Army Corps of Engineers. Other water management projects developed a multi-purpose usage but it was only in 1965 with the passing of the U.S. Federal Water Project Recreation Act (Public Law 89-72) that recreation was formally recognised as a valid and necessary consideration in water projects. From that time active consideration for recreation was a legal necessity in water project planning and this requirement has since been applied in differing degrees throughout the United States (U.S. National Water Commission 1973 p.173).

In Canada planning for multi-purpose reservoir operation is a provincial responsibility. As a result such patterns are variable across the country. Federal-Provincial co-operation was developed for a brief period under the Canada Water Act in 1970 (Bill C-144) and four major studies were started. These were the Canada-B.C. Okanagan basin studies, the Qu-Appelle basin studies in Saskatchewan, the Peace-Athabasca study in Northern Alberta and Saskatchewan, and the St. Johns River development study concerning Quebec and New Brunswick but also parts of Northeast U.S.A. (Davidson 1973). These studies were suspended after a

Federal Government of Canada change of ministers. Otherwise there is little evidence of any further co-operation. In part this study is an attempt to rectify this lack of investigation.

Benefits of Including Recreation in Multipurpose Reservoir Projects

Literature on this aspect of supply is deficient because of the problem of evaluating the benefits accruing from recreation. Other more tangible benefits of reservoirs can be and have been evaluated using simple cost-benefit analysis specifically using such parameters as tax returns, agricultural returns, energy costs and construction costs; however few authors have tried to evaluate recreation costs and benefits of water resource projects. Clawson (1966) has been one of the pioneers in applying cost-benefit analysis to recreation but has recognised the difficulty of quantifying and ranking the many diverse variables in recreation. More specifically Knetsch (1964 p.60) has tried to evaluate the benefits of recreation provision at water resource projects but in using the monetary gauge of "willingness to pay" suffers from the problem of inflexibility and the exclusion of many intangibles, such as recreation aesthetics and environmental consequences. However what the study does indicate by using a limited

number of parameters, is that recreational benefits from reservoirs can be great. Other studies using only one gauge have also indicated that great recreational benefits may result from multi-purpose projects. David (1968 p.701) showed a positive correlation between property values and recreation facility provision on a lake. Milliken (1970 p.50) et al showed how benefits could be obtained for different social classes using a variety of economic returns, while Day (1973 p.415) using visitor days and market cost indicated recreation may contribute as much as 36% to total project benefits at one site in Southern Ontario. Suggitt (1970 p.7) quoting the Corps of Engineers, quotes 21% and 31.5% for total annual benefits at another reservoir in Texas.

Most of these calculated benefits rely on readily quantifiable economic parameters. Little has been attempted on the quantification of intangible benefits such as landscape appreciation and environmental enhancement which rely heavily on subjective interpretation (Linton 1968). This should not detract from the value of attempts to measure benefits in economic terms which are good indicators of benefits and which do not make recreation benefits any less real. Knetsch (1974 p.113) has attempted to define economic and non-economic demand and supply parameters to show some implications for water resources planning but as

he readily admits this area of study is still in its infancy.

Inventories of Recreational Capability and Recreational Facilities at Hydro-Electric Power Reservoirs

For land capability for recreation there exists in Canada the A.R.D.A. Canada Land Inventory started in 1965 and now essentially complete (see Chapter 4). The U.S. Bureau of Outdoor Recreation produced on inventory of recreational resources in 1964 to ascertain the amount of recreational land present in the nation. Canadian development of resource inventories has been slower than in the U.S. where regional application of the inventory has been fairly extensive. In the field of facility inventory there does not exist in Canada a composite survey that includes a full definition of the recreation facilities available. Such information is listed for specific government agencies but it is not co-ordinated to any extent with other existing inventories. Government and private bodies in the U.S. have produced numerous inventories of recreation facilities. Two Outdoor Recreation Resources Review reports of the early 1960's were the earliest work of this kind. These have since been supplemented by documents such as "Recreation Opportunities at Hydro-electric Projects licensed by the Federal Power Commission" (U.S. Dept. of the

Interior 1970) and works by the large reservoir owners such as "Recreation - Civil Works Projects" by the Corps of Engineers (undated) and "Reclamations Recreation Opportunities" by the U.S. Bureau of Reclamation (1971). By 1976 the paucity of Canadian literature should be rectified in part by a collection of data on recreational use of hydro-electric power reservoirs by Environment Canada.

The Operation and Problems Associated with Recreational Use of Hydro Electric Power Reservoirs

Most of the current literature on operation of multi-purpose reservoirs uses computer programming to obtain a "best fit" for the optimum operation of multi-purpose reservoirs. However for this type of study to be quantified for computer input it is necessary to use economic terms which brings in the deficiency explained earlier concerning the lack of agreement on the economic status of recreation benefits. When more subjective assessments are made of the operation variables in using hydro-electric power reservoirs for recreation other problems are seen which would reduce the benefits. Ten such problems have been recognised in multi-purpose reservoir operation by various researchers. These problems are: fluctuating water level, particularly in hydro-electric power reservoirs; the provision of recreational facilities in areas of water fluctuation; the

fall in water quality when multiple use is made of water; bank erosion; the adverse effect of climate both directly inhibiting recreation participation and also causing such problems as bank erosion and debris accumulation; the destruction of fish and waterfowl habitat; the problem of lack of tree clearance below floodline in many reservoirs; access to and at the reservoirs; the problem of eutrophication in standing water bodies; and the decision as to whether a public or private body should develop and administer recreation on the reservoir.

A paper by Morgan (1971 p.765) was a significant contribution to the first problem, that of fluctuating water level. He tried to evaluate the benefit - loss function of fluctuating reservoirs but found no statistically significant relationship between water level and recreation attendance. However drawdown in his study area was only 3-10 feet. This conclusion is confirmed by David (1968 p.705) who showed that property values did not decrease when lake fluctuation extremes were more than 10 feet. This relationship was also suggested in the Outdoor Recreation Resources Review Commission (O.R.R.R.C.) Report Number Ten (1962). These papers contrast with a paper produced by Oregon State University Water Resources Research Institute (1969). In this paper fluctuation was recognised as a problem and planning measure were suggested to alleviate

this. Jaakson (1973 p.1230) also recognises drawdown as a problem but points out that only extreme drawdown constitutes a problem and that adaptation occurs for the smaller fluctuations. With most hydro-electric power reservoirs drawdown tends to be large and hence for this particular study it could to be a significant problem.

The provision of facilities such as docks and wharves relates closely to the above problem. The problem is one for public agencies since these bodies tend to be the major suppliers of facilities, especially in Canada. The Saskatchewan experience at Lake Diefenbaker is typical of the problem (Raby 1970 p.101). At Lake Diefenbaker a large reservoir causes drawdown shoreline fluctuation and makes the provision of facilities extremely difficult.

The problem of water quality is a local one. For instance Texan authorities, being concerned with water at the lower end of water basins, tend to have problems of industrial pollution while corresponding authorities in the middle and upper reaches of the basin often have problems of domestic supply. With regard to the latter aspect, this is a subject that has generated much controversy particularly concerning to the use of domestic water for recreation before consumption, since domestic water supply is often stored in reservoirs. Baumann (1969) has covered the "pro's"

and "con's" of the argument very well, and indicated the differing regional attitudes that prevail. The concensus now is to permit access to these reservoirs for recreation with some safeguards necessary to protect health. Alberta potentially has a problem with industrial pollution in the Bow Valley but close monitoring should not harm domestic or recreaticnal use.

The destruction of waterfowl, wildlife and fish habitat is a greater problem in Alberta. Reservoir construction disturbs fish ecosystems downstream from the dam owing to a greater variation in downstream flow. This can cause a loss in spawning grounds. Within the reservoir spawning grounds are destroyed by shoreline flooding at high stage and erosion at low stage and the overall carrying capacity is limited by the stratified nature of the water temperature, extra scour by underwater currents and the fluctuation of littoral feeding grounds. The Fish and Wildlife Division in the Government of Alberta (McDonald 1972) and British Columbia Hydro have done much to investigate this problem and fit policy measures at the reservoirs to this phenomena. For wildlife and waterfowl the problem is the destruction of both land and aquatic habitats by flooding. Little has been published on this particular problem. B.C. Hydro and the Saskatchewan government have been leaders in recognising and solving this problem.

The lack of tree clearance below floodline seems a problem peculiar to the forested areas of Canada. For example all B.C. Hydro reservoirs, some Calgary Power reservoirs in Alberta and reservoirs in Northern Saskatchewan (eg. Tobin Lake) are suffering from this. However this problem is no longer occurring because of clearance in most areas before flooding (Plates 4 and 5).

Access to reservoirs for recreation is again a local problem, and relates in part to reservoir and adjoining land ownership. In Alberta access to the reservoirs from public highways is often limited by private land owners, reservations for native peoples and cultural features such as railway lines. Calgary Power Company, the reservoir operators, expresses impartiality concerning access but access to some reservoir areas is prohibited because of dangerous installations. In the most part however, crown land surrounds the water body and access is thus theoretically unlimited. In a wider context, access quality and distance from populated places has been investigated to determine recreation demand and potential. A study to determine the effect on recreation of a paved road through the Kananaskis Valley in Alberta (Lombard Planning Ltd. 1972 p.26) indicated a significant impact while in a masterful study in Colorado, Milliken (1970) showed that reservoir

recreation opportunities were highly correlated to access.

The problems of climate and bank erosion are very much local conditions. Crowe (1973 p.3) showed how climate is related to recreation in a general way but he could not lay down local guidelines. In Alberta wind and water temperature are apparently the greatest problems (Provincial Parks, 1970). Water temperature never rises above 55°F owing to the immediate snow melt origin of the waters in the mountains, and this discourages swimming and other intensive water-based activities. Wind was seen as a problem at Lake Abraham owing to its frequency and speed (maximum 115 m.p.h.), while in the Bow System three lakes lie in valleys transverse to the mountain ranges and are thereby subject to the prevailing westerly winds. Bank erosion is a significant problem at Lake Abraham where banks are not yet stabilised and Brazeau where parent material on the banks is unconsolidated (Plate 6).

Eutrophication is a term applied to the changes in biological productivity through which lakes and reservoirs pass during their life cycle. The biological growth is aided by the natural sediment input to standing water bodies. This natural organic material and soil infilling takes a long time but human, industrial and agricultural waste waters carry many nutrients and stimulants to growth. To stop or

slow eutrophication, human sources of these nutrients must be limited and although this is not a problem in Alberta at present, it is an important consideration for the future.

The problem of reservoir development and control is a complex issue and cannot be fully discussed here. In part the question of whether an individual or company can best look after the interests of the public is a problem in definition of political objectives. It seems that for single use management, private enterprise is more than qualified to develop, but for multiple use purposes, especially those including recreation, government control (but not necessarily ownership) seems preferable. However this ignores the fact that governments by legislation can, and have controlled the private sector for the public good. This is certainly the case in the U.S.A. The argument for government control seems to be that the government alone has the capacity to control all the facets of demand both within and outside the particular water basin. Secondly, and more importantly, it seems more reasonable to expect a government body to provide the less tangible benefits of a reservoir, such as recreational facilities, for it is easier for a government to absorb costs. On the other hand, private control, it is argued, involves a greater amount of competition thus reducing costs. The literature is divided on the issue and most studies come out in favour of a

functional mix of control which is a compromise between both arguments. In many ways an indication of management alternatives can be clarified by an examination of regional approaches to water management (see below).

<u>Solutions to Problems and Resource Conflicts</u>

In a search for solutions to the problems four types of conflict are found. There is conflict between those who wish to install a reservoir and those who wish to preserve the natural stream. There is conflict between the reservoir operation and recreation; there is conflict on the reservoir between recreational activities; and conflict between uses that are not directly related to reservoir operation such as that between recreation and forest management. The simplest solution is that in which cost is judged as the sole criterion for reservoir operation and any use in which unreasonable or prohibitive cost is involved is automatically excluded. This is too simple a solution failing to take into account intangible benefits and is thus far too rigid. Other solutions have been proposed to offset individual problems: for lake level fluctuation limitation three solutions are possible. Either the land use causing the fluctuation (usually hydro-power) could be curtailed or supplementation of levels could be made from an upstream reservoir or from another basin. In both cases large costs

are invclved. The third possibility is to take no action against fluctuation whatsoever. David (1968 p.697), Morgan (1971 p.765) and Jaakson (1973 p.1230) all show that adaptation to fluctuation can occur. This seems a reasonable approach. For other problems the most widely used concept is that of zoning. In solving conflicts between recreational activities, zoning can take place in two ways. Firstly, it can be implemented so that the shore is divided into public use areas, private use areas and 'natural' areas where access is prohibited. The water area is buoyed to delimit swimming, water skiing, sailing and recreation-prohibited areas. Or, if conflict between recreation activities is still considered excessive, whole water bodies can be devoted to one use or a set of uses which do not compete with each other. Jaakson (1972 p.45) favours the first approach while the Battle River Planning Commission (1974 p.35) actively uses the second alternative. This use of zoning alleviates most of the problems outlined above: facility provision is aided by this scheme, bank erosion can be partly prevented by prohibiting access to the unstable area, wildlife habitat can be protected by isolation on a lake or partly circumvented and a functional mix of private and public recreation land can be provided for, using this system.

Conflict can also be minimised between recreation and

other land uses by means of this tool. Areas can be set aside fcr one land use or a variety of complementary land uses, and be spatially separate from other competing land uses. Furthermore this system is a positive way of controlling numbers gaining access to particular areas. This system is at present being used in the National Parks (Department of Indian Affairs and Northern Development 1970) within part of the study area and has been proposed for the eastern slopes of Alberta. To use this tool effectively a holistic and co-ordinated approach is obviously necessary for without it disjointed planning and conflict of interest can easily arise.

Other problems can be solved by more direct action. Tree clearance is one example where enhancement of recreaticnal apportunities can occur at reservoirs (Plate 2). Fish habitat loss can be offset to some extent by stocking reservoirs with species tolerant of reservoir conditions or by artifically providing spawning grounds as has been done in British Columbia. Water quality can be directly controlled by limitation of pollutants and eutrophication stopped by similar methods and by harvesting the biclogical deposits.

In total there seems to be a diversity of problems associated with reservoir recreation but concerted positive

action can do much to alleviate these problems and create a much fuller recreation experience at reservoirs than is currently possible.

Regional Approaches to Water Management

This review will be divided into four sections. The first section will be a review of literature produced in or pertaining to the mountain provinces of Alberta and British Columbia; the second section will be devoted to work produced for the Prairie Provinces of Saskatchewan and Manitoba; the third section will be a discussion of work from Eastern Canada including the Maritime provinces and the chapter will be concluded with a brief account of some of the wealth of literature produced in the United States.

ALBERTA AND BRITISH COLUMBIA: For Alberta there is a paucity of published material on the subject of recreational use of reservoirs. A number of official and unofficial reports for the Department of Lands and Forests , Parks Planning Division, and the Environmental Conservation Authority include examinations of particular problems at the reservoirs (McDonald 1972, Miller 1954, 1950, Thomas 1955, Parks Planning 1970). Such reports tend to be piecemeal and suffer from lack of integration into a co-ordinated land use plan for the management area in which the reservoirs lie. Thus response to demand has been limited and it reflects a

lack of co-ordination at the management level. In British Columbia the situation is different. Again a privately operated company (B.C. Hydro) is responsible for a public resource (water) but recreation has had fuller development in association with hydro-electric power. Much emphasis has been placed on the replacement of fish and wildlife habitat and tree clearance. This is a problem from which Alberta suffers greatly. In B.C. clearance is going ahead rapidly. Clearing was started on Slave and Buntzen Lake in 1971; Arrow Reservoir was largely cleared of timber before flooding in 1968; similarly Duncan was cleared in 1967; (B.C. pamphlet undated) Mica, Williston and Carpenter Lakes are in the process of being cleared (B.C. Hydro Progress 1972, B.C. Hydro news release 1972). Moreover, B.C. Hydro specifically states "priority in clearing is given to reservoirs adjacent to areas of greatest population density..." (N.C. Craig. B.C. Hydro. Personal communication). This is borne out in the pattern of clearance and is a direct response to the demand factors recognised in chapter one. For waterfowl, habitat has been zoned, and artificial spawning grounds have been created for migratory fish.

THE PRAIRIE PROVINCES: In the Prairie Provinces the nature of the terrain has resulted in more emphasis being placed on the use of reservoirs for a multiplicity of purposes rather

than on the dominant, almost single use of hydro-electric power reservoirs as in the mountain provinces. In particular the relative scarcity of large water bodies in the more populous parts of the prairies has meant that recreational use of both man-made and natural reservoirs has been considered a necessary contributor to the benefits of any standing water body. The need for the provision of water for a variety of uses has necessitated a high degree of integration in water management. This is particularly apparent in Saskatchewan. At the nucleus of the Saskatchewan network is Lake Diefenbaker. It is a recognised recreational area in itself (Raby 1970 p. 100) while at the same time its water irrigates local agricultural land, and supplements levels in Blackstrap and Little Manitou Lakes. The raising of levels in Blackstrap Reservoir is used to meet recreational demand and in Little Manitou Lake the purpose is to provide a separate waterfowl habitat. Furthermore the system guarantees a reliable high quality water resource for downstream users. When planned in conjunction with natural water bodies such as Last Mountain Lake and Buffalo Pound Reservoir the dearth of recreational opportunities is largely overcome. This degree of integration is made possible by water resource management being entirely goverment controlled. In Manitoba the situation is comparable. This has led to literature on recreation at the

Stephenfield Reservoir and at the proposed Patterson-Coulter Reservoir which are studies in response to growing demand for recreation in Southern Manitoba (Lombard Planning 1970). For the Prairie Provinces as a whole a study has been produced (Saskatchewan-Nelson Study 1972) in which water problems for the entire region have been investigated. As well as outlining the problems involved, the study puts forward solutions for their alleviation. It has become a valuable complement in water management to the water resource studies produced by the Prairie Provinces Water Board (Laycock 1957).

EASTERN CANADA: The literature produced in Eastern Canada is concerned with a greater diversity of issues on recreation than that in the West. Much has been written on water management of the Great Lakes (Great Lakes Basin Commission 1971) particularly on water pollution (International Water Pollution Board 1969). General social issues in recreation have been explored, (Day 1973, Jaakson 1973) some work on water resource management of particular areas has been significant, (Great Lakes Basin Commission 1971) other documents exist on Provincial Parks and climate but little work appears on reservoir recreation. In the Maritime Provinces the marine shoreland has mainly satisfied the demand for water-based recreation although in some areas reservoir recreation could become a significant contributor

to outdoor recreation opportunities (Atlantic Development Board 1969).

THE UNITED STATES: There exists a wealth of literature on the U.S. experience in water management but it is too wide ranging to be fully covered here. Two studies that have been noteworthy include a report by the Illinois Technical Advisory Committee on Water Resources (1967) and a report by the Pacific Northwest River Basins Commission (1971). In the former, which is one of many state studies, the demands of different water users were evaluated, recreation activities were discussed, and the resource base was ascertained. The report comes out in favour of publicly owned, zoned, multipurpose reservoirs and recommends integrated resource management and planning. In the latter, the Pacific Northwest River Basins Commission evaluated demands and needs, the resource base and the role of recreation in terms of costs, benefits and problems. In sub-regional analysis the needs of the particular region were isolated and the solutions to meet the needs were discussed. It is the most comprehensive study found in the literature covering both general and specific needs for a management area. Most other management documents relate to the needs of a particular state. For instance, Texas (1962) is concerned with recreation in water of a low quality while Wisconsin (1959) has the water resources but has problems of allocation and

development. Another noteworthy study in regional water management is that in the Delaware river basin, (Whipple 1974). In attempting to control the Delaware river, comprehensive planning to accommodate other uses is vital. This involves the need for close federal and interstate cooperation to effectuate a management policy. Other state studies worthy of note include those conducted in Minnesota (1970) and Nebraska (1971). In evaluating the resource bases and policies these studies are excellent examples of the type of study needed for regional water resource management.

Valuable work on recreation has also been conducted, at a federal level, by the Resources for the Future and the U.S. Bureau of Outdoor Recreation. In particular, studies by Clawson (1959) Knetsch (1964) Kneese (1962) and Cicchetti (1969) are of particular interest.

The experience in the United States is in large part a response to the pressing demand factors. Although demand for water is not yet as high in Canada, it is imperative that the future demands should not be ignored. It is thus necessary to ascertain the supply of resources that will meet this demand and the management alternatives available for allocation of the resources.

EUROPE: In Britain there has been less emphasis on regional water management than in North America. One national issue

has been on water supply for the industrial areas. In particular the supplying of Welsh and North of England water to the industrial areas of Northern and Central England has been of concern. (Cumberland County Council 1971. Rees 1972). Connected with this issue has been the need to solve water quality problems in urban and industrial areas.

In continental Europe regional water management is practised to a greater extent then in Britain. For example in West Germany the Landesplanungsbehorde are responsible for dealing with regional water problems. This state agency has been concerned particularly with water transport and efficient waste disposal in the industrial areas. In France comprehensive development of mountain areas for power, navigation and irrigation has been an important feature of water resource development.

On a world scale, the United Nations has been involved in many water resource projects, principally those which stress greater development through flood control, irrigation and power. Many of the schemes are large in a national sense. In particular, development schemes in North Africa and Asia have been on a large scale (United Nations 1957, 1958, 1966).

In conclusion it has been seen just what problems have been encountered in the operation and use of reservoirs for

recreation. In addition the management approaches that have been taken to meet these problems have been discussed. With this background information, it is now possible to assess the physical and human resource patterns that are found at the hydrc-electric power reservoirs of Alberta in order to suggest cptimum use for the areas under study.

Chapter 4

THE PHYSICAL POTENTIAL OF THE STUDY AREA FOR RECREATIONAL AND RELATED LAND AND WATER USES

The rising participation rates noted in chapter two are reflected in the general visitor statistics for parks and other outdoor recreation facilities frequented by Albertan and out-of-province visitors in or close to the study area (see chapter two). These statistics suggest that many such areas are used very close to if not beyond capacity during peak summer periods. This continued rise of visitors is directly attributable to the factors outlined in chapter two. Appropriate alternatives to meet this growing demand are required now or in the near future, for there is little indication that the factors inducing the rising demand will change.

In order to assess the outdoor recreation potential of the hydro-electric power reservoirs of Alberta an examination of the physical resources of the study area is necessary. These resources of physiography, climate, vegetation, soil, water and wildlife must fulfill the recreation need and their nature will be to either enhance or detract from the recreation experience. This chapter is an examination of each of these resources in turn and an

indication of their influence and effect upon recreation. The demands placed on the resources for other land uses will also be noted.

Physiography and Geology.

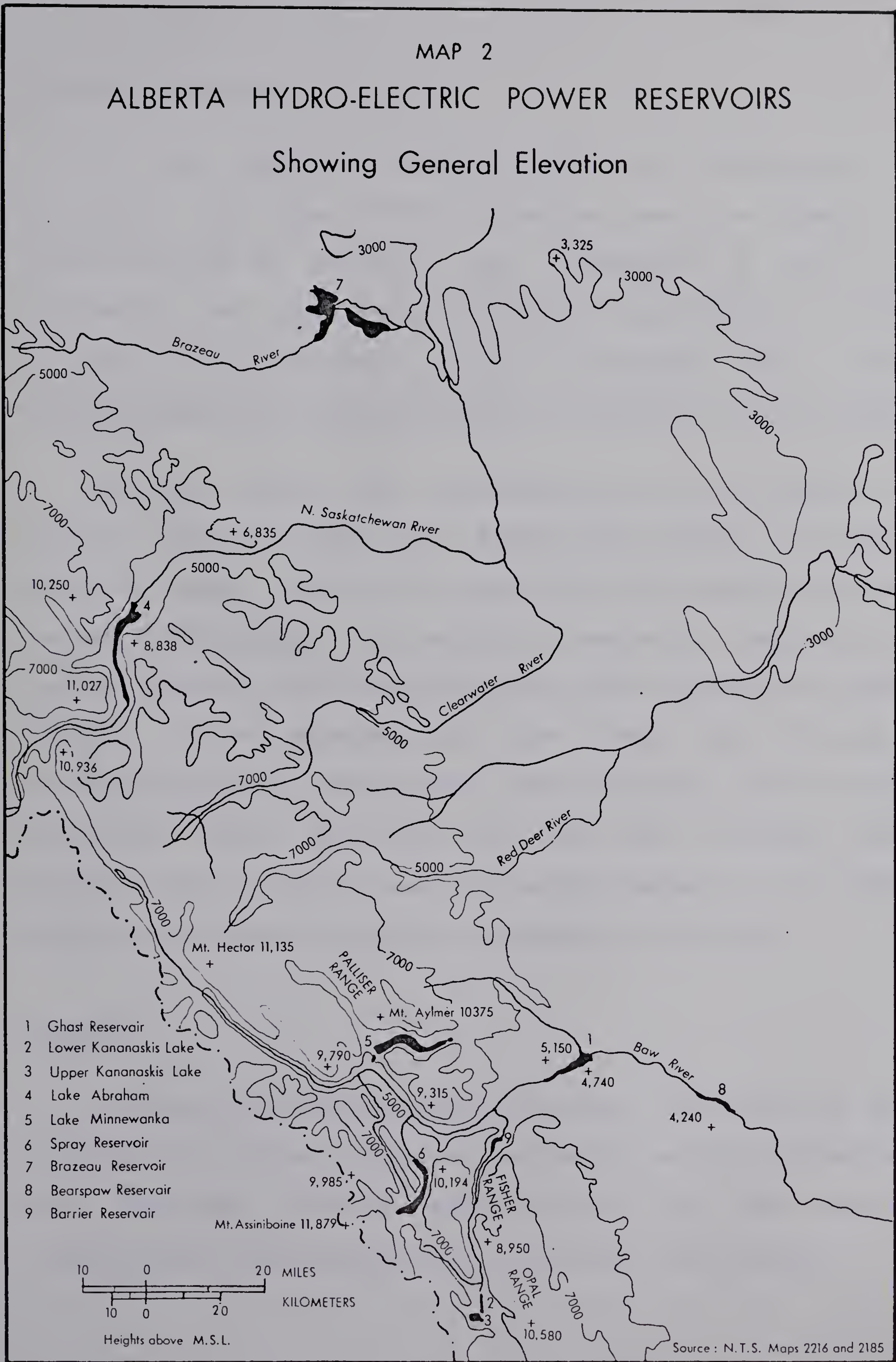
The hydro-electric power reservoirs of Alberta are found in three physiographic regions: the mountains, the foothills and the plains. The mountains and foothills are highly faulted parts of a huge anticline whose apex lies at the Alberta-British Columbia border. The rocks of the mountains are mainly imbricate palaeozoic limestones, dolomites and quartzites while further east in the lower foothills the sheets are draped with mesozoic clastics. The strata becomes progressively older westward. The Kootenay and Palliser formations of the Upper Cretaceous and Devonian have coal and limestone beds which form the basis for mining activity in the Bow Valley. Subsequent to orogenesis differential erosion occurred in the mountains and this has helped to produce a series of parallel and sub-parallel northwest-southeast trending fault ridges. (24th International Geological Congress Field Reports 1972, Marshall 1921, Warren 1927, Belyea 1960)

The plains are underlain by a relatively undisturbed sequence of phanerozoic sedimentary rocks which directly

overlie the gently westward dipping Canadian Shield. This sequence is just part of a very much more extensive region that extends eastward into Saskatchewan and Manitoba, northward into the Northwest Territories and southward into Montana and the Dakotas.

Glacial and fluvio-glacial activity has contributed many features familiarly associated with the presence of ice and water. U-shaped valleys, drift deposits which now form valley terraces, moraines, kames, general lacustrine sediments and outwash plains are all found in the study area (Rutter 1966, Walker 1971). The terrace gravels of the foothills belt are extensive enough around Bearspaw to form a significant resource to be quarried (Alberta Society of Petroleum Geologists 1968, 1970).

The different geologic history of the reservoir areas under study has resulted in varied topography. In the mountains the mountain ridges (The Front Ranges: eg. Kananaskis, Opal, Misty Ranges) all rise to above 9000 feet and some peaks are over 10,000 feet (Mt. Lougheed, Mt. Aylmer) (Map 2). This is a local relief of 5000 feet since the valley floors, in which most of the mountain reservoirs are found, are between 4,000 and 6,000 feet above sea level. This feature is ideal for recreation as such topographic variation is spectacular in a scenic and aesthetic sense


MAP 2
ALBERTA HYDRO-ELECTRIC POWER RESERVOIRS
Showing General Elevation
3000
3,325
3000
7
Brazeau River
5000
3000
7000
N. Saskatchewan River
+ 6,835
5000
10,250
4
+ 8,838
3000
7000
11,027
Clearwater River
5000
10,936
7000
Red Deer River
7000
5000
7000
Mt. Hector 11,135
PALLISER RANGE
7000
Mt. Aylmer 10375
5
9,790
5,150
1
4,740
Bow River
8
4,240
9,315
5000
7000
6
9
9,985
10,194
FISHER RANGE
Mt. Assiniboine 11,879
7000
8,950
OPAL RANGE
7000
2
3
10,580
1 Ghost Reservoir
2 Lower Kananaskis Lake
3 Upper Kananaskis Lake
4 Lake Abraham
5 Lake Minnewanka
6 Spray Reservoir
7 Brazeau Reservoir
8 Bearspaw Reservoir
9 Barrier Reservoir
10 0 20 MILES
10 0 20 KILOMETERS
Heights above M.S.L.
Source: N.T.S. Maps 2216 and 2185

(Plates 7 and 8).

In the eastern foothills where the elevation is generally less than 5000' above sea level the country is best described as rolling. This topography is good for recreation not only for its inherent qualities but is also of value for its proximity to the mountains, which often form an important scenic backdrop for recreation activities.

In the plains the reservoirs are at an elevation of between 3,000 and 4,000 feet. However the nature of hydro-electric power production means the site usually has some relief differential. At Bearspaw Reservoir, post-glacial valley incision has created terraces which provide the local relief. At the Brazeau site the river cuts through a resistant geologic outcrop and this provides some relief variation. These features are good for cottaging when located close to urban areas but relief variety is not great enough to encourage intensive land-based recreation.

CLIMATE

Climate has always exerted a strong influence on the location and nature of outdoor recreation activity. Planning can therefore benefit substantially from the serious consideration and application of climatic information.

Crowe, Mckay and Baker (1973) have isolated three aspects of climate that directly influence outdoor recreation: firstly the existence of a climatically controlled resource be it snow, warm water or an aesthetic natural milieu; secondly the personal comfort factor (Is it too cold for swimming and skiing? Is it too hot for hiking?); thirdly the occurrence of unfavorable weather conditions, such as high winds, which inhibit outdoor satisfaction or even participation. Unfortunately these factors are difficult to evaluate (for the study area) owing to the lack of detailed data. Moreover in the mountains and foothills locational and altitudinal controls are strengthened and large variations in climate diurnally, weekly, monthly and annually can be expected which would not be reflected unless micro-climatological studies were conducted. Thus in evaluating the above factors the data used are not representative of all areas (Tables 1 - 3) (Map 3).

As no recording stations exist at Spray Reservoir or Lake Minnewanka data for Banff and Anthracite are used. For Barrier Reservoir the Kananaskis Experimental Station data are used. Where no data for Kananaskis Lookout exist, the experimental station data are also used for Upper and Lower Kananaskis Lakes. Calgary and Cochrane data are the nearest equivalent to Ghost and Bearspaw and where Big Horn Damsite

TABLE 1

TEMPERATURE DATA FOR SELECTED STATIONS IN THE STUDY AREA

Mean Daily Temperature

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Anthracite	13.1	19.5	25.4	37.1	46.8	52.4	58.6	56.3	48.5	39.8	25.5	17.8	36.7
Banff	11.9	19.8	25.2	36.2	45.5	52.1	58.1	56.1	48.3	39.5	25.2	16.3	36.2
Brazeau Lo.					48.4	53.8	59.4	57.0	49.2	41.0			
Calgary	12.8	19.3	24.7	38.0	48.6	55.1	61.1	58.8	50.8	42.1	28.1	19.5	38.2
Kananaskis S.	14.6	21.1	24.5	35.3	44.7	51.2	57.4	55.6	48.6	41.0	27.9	21.0	36.9
Kananaskis Lo.						46.0	53.8	51.5	43.8	33.4			
Lake Louise	6.6	14.5	24.3	30.9	42.3	48.5	53.4	52.6	45.7	33.1	12.0	12.9	31.4
Nordegg				33.3	43.2	49.2	54.6	53.1	45.0	37.4	23.5	12.7	

Mean Daily Maximum Temp

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Anthracite	22.1	30.2	36.9	48.7	59.9	64.9	72.9	69.8	60.8	49.9	33.6	25.6	47.9
Banff	21.1	30.7	36.5	47.0	57.6	64.0	72.2	69.8	60.8	49.4	33.3	24.0	47.2
Brazeau Lo.					59.3	63.9	69.8	67.1	59.3	50.4			
Calgary	23.2	29.8	35.0	49.2	59.9	65.9	73.3	71.2	62.5	53.6	37.9	29.4	49.2
Kananaskis S.	26.0	33.0	36.3	46.7	56.9	63.4	71.7	69.2	61.4	52.4	38.4	31.4	48.9
Kananaskis Lo.						54.3	61.8	66.4	64.0	57.1			
Lake Louise	19.4	31.3	39.7	43.4	57.0	61.8	70.7	69.0	59.8	43.1	22.7	23.6	45.1
Nordegg				47.0	58.4	64.2	70.4	69.0	60.3	51.8	35.7	26.5	

	Calgary	Kananaskis S.	Banff
Date of Last Frost:	28th May	27th June	23rd June
Date of First Frost:	15th Sept	24th Aug.	16th Aug.
Frost-free period:	110 days	58 days	54 days

Source: Monthly Record
Environment Canada
Atmospheric Environment

TABLE 2

PRECIPITATION DATA FOR SELECTED CLIMATIC STATIONS IN THE STUDY AREA

Mean Rainfall

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Anthracite	0.02	0.04	0.05	0.32	1.79	2.69	1.86	2.14	1.3	0.62	0.16	0.08	11.07
Banff	0.02	0.04	0.06	0.35	1.66	2.51	1.89	1.90	1.26	0.77	0.22	0.10	10.78
Brazeau Lo.					1.92	4.23	4.37	3.14	1.96	0.37			
Calgary	0.01	0.01	0.03	0.31	1.58	3.10	2.78	2.38	1.02	0.25	0.03	T	11.50
Cochrane	0.02	0.01	0.05	0.48	1.45	3.67	2.84	2.57	1.01	0.35	0.05	0	12.5
Kananaskis S.	0.02	0.01	0.04	0.32	2.4	4.38	2.58	2.75	1.68	0.54	0.11	0.06	14.84
Kananaskis Lo.						2.99	2.3	2.65	1.33	0.35			
Lake Louise	1.56	1.55	1.05	0.5	2.93	0.66	1.63	1.82	0.72	1.46	3.27	2.31	18.96

Mean Snowfall

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
Anthracite	10.9	10.8	7.8	9.2	3.7	0.4	0	T	3.0	7.1	10.5	11.6	75.0
Banff	14.0	11.7	9.1	11.8	3.7	0.5	0	T	2.3	7.1	12.5	13.4	86.1
Brazeau Lo.					4.1				1.8	6.6			
Calgary	7.3	7.3	7.8	10.2	3.9	0.8			3.0	3.5	6.8	6.8	57.4
Cochrane	9.2	8.9	11.0	14.0	7.0	1.2	0	T	5.4	6.8	8.2	8.5	80.2
Kananaskis S.	11.0	13.6	14.6	21.1	8.1	0.3	0	0.2	3.7	10.1	10.6	11.3	104.6
Kananaskis Io.						10.4	0.2	1.6	9.1	12.7			
Big Horn Dam													104.7
Lake Louise	15.6	15.5	10.5	5.0	6.5	0.9	0.1	0.1	0.4	7.5	32.7	23.1	116.4
Nordegg					3.3	0.1	0	0	1.4	6.8			
Rocky Mtn Hse	10.0	9.1	10.2	11.5	3.1	0.1	0	0.1	2.0	6.3	8.0	9.3	67.7

	Calgary	Banff
Average Appearance date of snow cover =	Oct 18	Oct21
Average Disappearance date of snow cover =	May 4	May 8

Source: Monthly Record
Environment Canada
Atmospheric Environment

TABLE 3

SAMPLE DATA FOR FOUR STATIONS IN THE STUDY AREA IN 1972

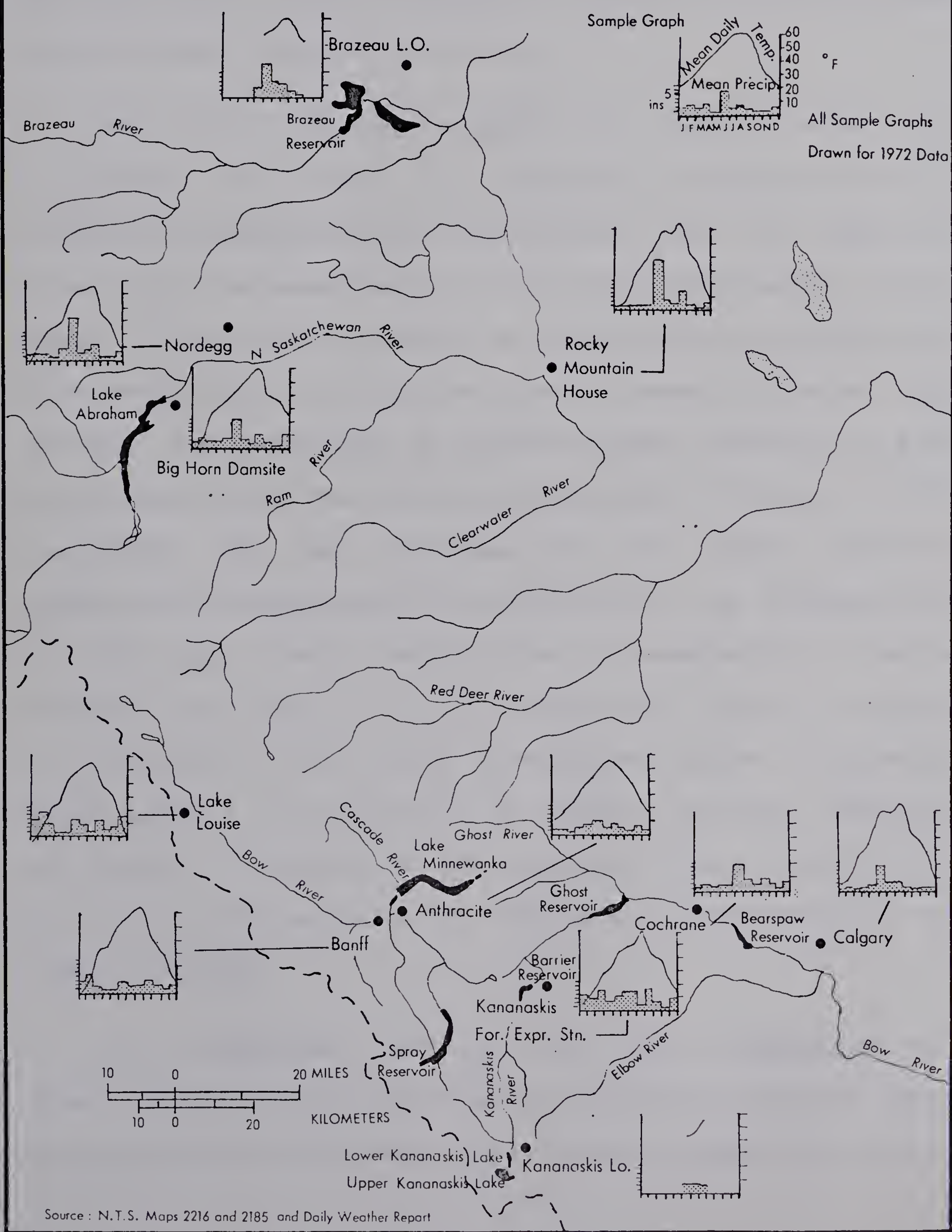
	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
BANFF													
Mean Temp	4	15	31	34	47	54	56	61	42	37	28	9	35
Total Precip.	2.62	4.24	1.36	0.83	0.64	3.01	1.82	1.38	3.08	1.26	0.2	2.15	22.5
Total Snow	32.9	55.9	14.9	7.3	1.9	0	0	0	7.6	15	3.4	34	179.3
Max Wind	35	28	25	28	27	25	20	20	28	25	28	22	
Mean Wind	8.5	7.9	5.9	7.1	5.1	6.7	5.6	5.2	5.9	6.2	7.0	8.0	
Sunshine hrs.				155	197	197	259	210	167	126			
BIG HORN DAMSITE													
Mean Temp.	0	12	27	34	47	54	53	60	41	36	28		
Total ppt	1.14	2.39	1.91	1.35	1.77	6.5	2.34	1.49	3.83	1.05	0.74		
Total Snow				13.5	12.0	0	0	0	10.4	9.2	7.4	17.5	
Max Wind	m	62	50	49	29	39	28	29	46	43	40	m	
Mean Wind	m	9.1	10.6	14.1	7.9	9.7	6.8	6.3	8.6	11.2	10.2	m	
Sunshine hrs.													
CALGARY													
Mean Temp	4	10	29	37	50	59	58	63	45	39	31	12	36
Total ppt	0.9	0.68	0.92	0.43	1.08	6.27	3.11	1.63	1.84	0.72	0.72	0.87	19.86
Total Snow	10.0	6.8	9.0	4.0	0	0	0	0	5.4	6.2	7.2	8.7	57.3
Max Wind	46	55	41	40	46	35	34	33	37	38	40	36	
Mean Wind	13.4	9.9	10.4	13.2	1.3	10.9	9.6	8.2	10.4	10.8	9.1	9.1	
Sunshine hrs.	99	121	156	196	237	240	317	278	188	166	116	94	2208
KANANASKIS RESEARCH STN													
Mean Temp	6	13	30	34	47	53	54	61	42	38	30	15	
Total ppt.	3.4	2.72	3.8	2.01	m	3.02	4.12	1.58	4.53	1.89	0.64	2.79	
Total Snow	34	27.1	38.0	20.1	0	0	0	0	11.9	18.9	6.4	27.9	184.3
Max Wind	35	29	27	28	16	25	20	20	23	21	26	30	
Mean Wind	5.5	5.6	6.6	8.0	5.4	7.1	4.6	4.3	5.5	5.4	6.3	6.3	
Sunshine hrs.	70	128	m	246	201	236	332	248	163	121	62	50	

Source: Monthly Record
Environment Canada
Atmospheric Environment

MAP 3

ALBERTA HYDRO-ELECTRIC POWER RESERVOIRS

Showing Selected Climatic Stations



Source : N.T.S. Maps 2216 and 2185 and Daily Weather Report

and Brazeau lookout data do not exist, Nordegg and Rocky Mountain House are taken as representative stations (Map 3). Data for Lake Louise are given to indicate climatic patterns in the higher mountain locations.

The data compiled indicate to some extent the influences of climate on recreation outlined above. The effect of precipitation in the form of snow is especially great in the mountains. At Kananaskis Experimental Station (Table 2) the first snowfall is in mid-October and from this time onward until mid-May the area is covered by snow. This feature is sufficient to inhibit access. Combined with the low temperatures, the onset of snow marks the end of summer recreation and the beginning of the winter recreation season. This season ends in mid-May with the disappearance of the snow cover and the rise in temperatures. From the Calgary data (Table 3) it can be seen that winter is shorter in the plains. At the North Saskatchewan System reservoirs, Lake Abraham is comparable to southern mountain reservoirs and Brazeau is similar to the southern plains reservoirs for the lower elevation of these reservoirs compensates for the higher latitude.

Air temperature affects the water temperature to a great extent. In the mountains the reservoir water is mainly from snow melt and is very cold. Summer temperatures are not

high enough to raise the temperature to a tolerable level for swimming and hence recreation in this form is not possible. In the foothills and plains reservoirs, water temperatures can rise to a tolerable level and swimming is possible, but there are warmer water bodies available elsewhere.

The personal comfort factor is closely associated with air temperatures. In particular, the mean minimum, maximum and daily temperature (Table 1) will affect such activities as camping, hiking and cottaging. From Table 1 it can be seen that April is the first month, and October the last in which mean daily temperatures rise above 32°F. in the mountains. This date of freezing is later in the lower elevations of the foothills and plains as shown by the date and number of frost free days.

An unfavorable weather condition of the study area is wind. It is particularly strong where westerly winds are channelled through gaps in the front ranges. At Lake Abraham (Table 3) mean wind speed is high and maximum speed is over 60 m.p.h. Winds of 115 m.p.h. have been recorded at the damsite. This is in part due to the 20 mile fetch possible at the lake. In the Bow System, Lake Minnewanka, Upper Kananaskis Lake, and to some extent Spray Reservoir all lie in valleys transverse to the mountain ranges and are

therefore subject to the prevailing westerly wind. Their main reaches are dangerous for small power craft and ill-suited for sailing although some boating takes place in sheltered reaches with good access for day users. Lower Kananaskis Lake, Two Jack Lake and Barrier Reservoir are naturally more protected and can be used for boating and fishing to a greater degree (Plates 9-11).

Although winds can be high in the plains they do not constitute as great a problem at Ghost, Bearspaw and Brazeau (Table 3).

Few other records exist on which to gauge the climatic effect in the study area. Sunshine records for Kananaskis, Banff and Calgary exist (Table 3) showing a high incidence of sunshine in the mountain valleys in summer months but this is a lesser control. Recreation is the only land use at the reservoirs that is controlled so much and so directly by these climatic variables.

SOIL

The importance of the soil resource to recreation is small. It is important when considering road construction for access, a foundation for building on,shoreline erosion, and campsite location, (A sandy soil will have rapid drainage after a shower), but this is virtually the limit to

its influence. It is more important to other, possibly competitive, land uses such as agriculture, forestry or mining and cannot be neglected.

Topographic variety, differing parent material and a variable climate have contributed most towards the varied and complex soils of the study area. This has inhibited both soil classification and the establishment of zonal soil divisions. Mapping for the greater part of the area is thus not complete. Only in the southern prairie region can clear soil horizons be widely traced. Here a chernozemic soil profile has developed above the till. It is characterised by a dark 'A' horizon and a lighter 'B' horizon. It is particularly fertile and can be found in the area immediately west of Calgary, around Bearspaw Reservoir. Lightening and thinning of the soil occurs westward from Bearspaw, largely because of greater precipitation. When traced into the mountains the large topographic variation results in soil pattern types too complex to be mapped. Six descriptive terms have been applied by the Eastern Rockies Forest Conservation Board (Laycock 1957) for management purposes: bare rock and rocky alpine; residual; colluvial; glacial; alluvial and fluvio-glacial; and bog and marsh. Podzols can also be recognised in lower forested areas. The soils in the mountains have in general a low productivity for agriculture. Some range land exists in the south but

overgrazing has caused soil instability and erosion. Mineral exploration has also caused erosion in some eastern slopes localities. In the North Saskatchewan river basin limited livestock grazing has taken place in the Big Horn Dam area while at Brazeau large tracts of bog soils and highly leached grey-wooded soils have discouraged agricultural use. Overall there is little conflict between agriculture for cultivated crop production and recreation in the area around the reservoirs, although commercial grazing is a significant competitive use elsewhere.

FLORA

Unlike soils, vegetation can have a more direct influence on the potential of an area for recreation. Its presence can greatly enhance the environment for many recreational pursuits. The hydro-electric power reservoirs of Alberta are found in four ecozones: the prairie ecozone, the boreal cordilleran; the foothills and the mountain ecozone (Moss 1955).

In the prairies, the location of Bearspaw Reservoir, grasses dominate. Rough fescue (*Festuca scabrella*) blue gramma (*Bouteloua gracilis*) and little bluestem (*Andropogon scoparius*) are prominent. Willows (*Salix* spp.), aspen (*Populus tremuloides*) , and even spruce (*Picea* spp.) are

found on the north facing slopes and in the wetter hollows where groundwater flow adds significantly to water availability.

The Boreal-Cordilleran ecozone, in which Brazeau and Lake Abraham are located, is an extension of the northern Boreal forest as it merges in the west with the mountain forests. Lodgepole pine (*Pinus contorta*), white spruce (*Picea glauca*) and trembling aspen (*Populus tremuloides*) dominate. White birch (*Betula papyrifera*) is present, while the larch (*Larix laricina*) is found in the wetter muskeg depressions. It is important to note here that west of Lake Abraham the broad valley, known as the Kootenay Plains, lies in a rain shadow and is thus warmer and receives less precipitation than the surrounding country. As a consequence, grassland vegetation has developed on the drier sites expecially on the coarse-textured terrace and floodplain soils. Such vegetation provides excellent winter range for wildlife. In historical times, the horses of the Indian tribes of the central foothills used this area as their wintering grounds. The area has good potential for trail riding as well as wildlife viewing.

The foothills zone is an altitudinal transition from grassland in the drier areas at lower elevations to forest in the cool and moist higher elevations. Trembling aspen is

the dominant species but lodegepole pine and spruce are widespread in the wetter, more elevated and north facing sites (Farley 1972). Ghost Reservoir is located in this foothills ecozone.

The mountain forest ecozone is by far the most important zone for the vegetation resource it contains. It is a mixed forest of climax white and black spruce (Picea mariana) with successional lodgepole pine, aspen and balsam poplar (Populus balsamifera) and black cottonwood (Populus trichocarpa). The alpine forest cover of the highest elevations has lodgepole pine mixed with alpine fir (Abies lasiocarpa) and englemann spruce (Picea engelmannii). Douglas fir (Pseudotsuga menziesii) is found at the lower elevations. Alpine meadow can be found at the highest elevations above the treeline (Moss 1955).

The vegetation pattern is caused in large part by the history of the area. Forest fires and commercial logging have been extensive for many years throughout the mountains (Nelson 1970). In the two decades following the completion of the Canadian Pacific Railway (C.P.R.) in 1885 extraction of timber from the Bow, Spray, Kananaskis and other valleys was careless, wasteful and the cause of many fires (Byrne 1968). In 1910 the Rocky Mountain Forest Reserve was established 'for the protection and reproduction of timber'

(Canada Statutes 1911). However burning was not eliminated and was not greatly inhibited until the Eastern Rockies Forest Conservation Board was established in the late 1940's.

Lodgepole pine is the pioneer species when destruction of the forest occurs but white spruce gradually replaces pine as it is the climax form. Thus the forests are generally a mixture of lodgepole pine and white spruce.

Logging was common the study area until relatively recent times. The Cascade Valley in Banff National Park was logged during World War Two; the last sawmill closed in the Kananaskis Valley in 1944; logging was extensive south of Spray Reservoir until a few years ago; timber has been extracted near Brazeau and Lake Abraham in the past decade and timber harvest is still occurring along Smith Dorien Creek, South-east of Spray Reservoir, and is a significant land use.

WATER RESOURCES

In order to plan the use of water as a manageable resource, it is necessary to understand the natural regime and yield patterns in the study area. Briefly it is to be noted that in a dry year, such as 1948-49, the Forest Reserve and the mountain park areas of the Alberta Rockies

supply 87 per cent of the flow of the North and South Saskatchewan river basins, even though the area involved covers only 13 per cent of the basin area (Laycock 1965). This is noteworthy when considering downstream users. The flow is dependable, has a good, though not ideal regime (relative to other uses such as irrigation) and is of a high quality. This is in contrast to both the lower foothills, where the flow is lower in amount, turbid, early and flashy, and the plains which have undependable flow and may be absent in dry years. Hydro-electric power development and operation have modified this regime pattern. In Table 4, the operating characteristics of the individual reservoirs are outlined. Generally, drawdown occurs in the winter when power demand is greatest. Spring run-off is stored in the reservoir as replenishment for the winter drawdown. The time of complete replenishment when maximum elevation of water level is reached varies in different reservoirs. The variation is dependent on the extent of drawdown, the power needs throughout the year, the location of the reservoirs, the type of power plant, and the amount and timing of spring run-off. This maximum elevation is maintained until winter drawdown for power again occurs. The overall effect on regime is to give a more equable flow downstream throughout the year but dry or low river courses can still occur.

In the foregoing discussion the operation of the

TABLE 4 HYDRO DEVELOPMENTS IN ALBERTA

Year Commissioned	Project	River	Storage	Pondage	Power	Gross flowby without spill cfs	Range of Full Drawdown	Period of Normal Use (powerplant)	Type of Plant	Volume of Gross Storage cfs dys	Carryover Storage cfs dys	Net Capability in megawatts	Remarks
*1932	Upper Kananaskis Lake	Kananaskis	x			400	5541-5511	Dec.-Mar.	--	18,000			replaced 1942 by larger storage
1942	do.	do.	x			350	5583-5529	Nov.-Feb.	--	50,000	12,000		orifice release until 1955; carryover 5545 to 5530
1955	Interlakes Plant				x	800	do.	Oct.-Feb.	load factor			6-3	utilizes storage in Upper Kan. L
*1955	Lower Kananaskis Lake	Kananaskis	x				5469-5425	Feb.-Apr.	--	25,000	Nil		storage mostly filled by end of June
1955	Pocaterra Plant				x	1100	do.	Oct.-Apr.	load factor			15	utilizes storage in Lower Kan. L
*1947	Barrier Plant	Kananaskis	x	x	x	1300	4515-4480	12 months	load factor	--	Nil	12	drawdown in April, replenished June
*1912	Lake Minnewanka	Cascade	x			260	4775-4763	Dec.-Mar.	--	22,000	--		replaced 1942 by larger storage
1942	do.	do.	x				4840-4805	Oct.-Apr.	--	91,000	46,000		carryover storage 4823
1942	Cascade Plant				x	750		do.	load factor			18	utilizes storage in L. Minnewanka
1957	Cascade Pl. Ext.				x	750		do.	peaking			18	second turbine installed
*1950	Spray Reservoir	Spray	x				5583-5527	Oct.-Apr.		105,000	38,000		carryover storage 5552 to 5527
1951	Three Sisters Pl.				x	900		do.	load factor			3-1	tailrace discharges to Spray canal
1951	Spray Plant			x	x	770		do.	load factor			50	tailrace discharges to Rundle canal
1960	Spray Pl. Ext.				x	770		do.	peaking			50	second turbine installed
1952	Rundle Plant			x	x	700		do.	load factor			17	tailrace discharges to Bow at Canmore
1960	Rundle Pl. Ext.				x	1400		do.	peaking			33	second turbine installed
1913	Kananaskis Plant	Bow		x	x	1900	4200-4196	12 months	run of river			10	pondage tiny, limited peaking
1951	Kan. Pl. Ext.				x	1800		do.	do.			9	third turbine installed
1911	Horseshoe Plant	Bow		x	x	2700	4126-4121	do.	run of river			14	pondage small, reduced night load in winter
*1929	Ghost Plant	Bow	x	x	x	3700	3910-3883	do.	load factor			28	drawdown May-June for limited flood control
1954	Ghost Pl. Ext.			x	x	3300		do.	peaking			23	fourth turbine installed
*1954	Bearspaw Plant	Bow	x	x	x	5500	3580-3573	do.	base load			17	pondage small
*1965	Brazeau	Brazeau	x	x	x		3170-3110	12 months	peaking	11,200		355	
*1973	Big Horn	N. Saskat.	x		x		4335-4215	12 months	load factor	13,760		120	
	TOTAL									235,960		800	

Source: Calgary Power Ltd.
*The Reservoirs

reservoirs in fulfilling their primary function of producing reliable hydro-electric power was outlined. The water resource is also needed for other uses and the presence and operation of hydro-electric power reservoirs is competitive and complementary to varying degrees with these other uses.

Recreation: For recreation the primary conflict is over drawdown. This not only affects access to the water and provision of facilities on the adjoining land but it affects downstream recreation. Angling in particular is affected. Low spring flow inhibits spawning, the dams stop upstream movement of fish and the streamflow is often insufficient to create the necessary pools for good fish habitat. This problem is particularly acute in the Spray and Kananaskis Valleys where the installation of the dams has severely disrupted streamflow. In the Spray River attempts have been made to guarantee a constant streamflow but the success has been limited and conflict between fishing and hydro-electric power use is still present (Macdonald 1972).

Flood Control: A measure of flood control is inherent in hydro-electric power operation when high spring run-off is stored. However this does not result in a large reduction in the potential for flooding downstream because much of the spring refill is from snow-melt which is very dependable. In contrast much of the flooding is from late-spring and early-summer rains which vary greatly from year to year and which

may occur when reservoirs have been largely filled for power purposes. There is little or no provision for flood control during spring refilling or during late spring-early summer rains. This need not be so. Reservoir filling could be made more responsive to summer snowmelt in higher areas and hence have the capacity to accommodate unexpected heavy rainfall. Unfortunately this would lengthen the time taken to fill the reservoir and hence detract from the summer recreational enjoyment of the reservoir.

River Flow Augmentation: Flow augmentation in winter is a beneficial although generally coincidental use of the hydro-electric power reservoirs. Augmentation of river flow in Alberta during the winter is desirable for maintenance of water quality for urban, industrial and other uses downstream.

When flows are low (in winter) a river's ability to assimilate and biologically degrade wastes is low. The problem is accentuated in Alberta by the fact that ice formation lowers the oxygen content and thus lowers the ability to assimilate waste. Release of water in winter for power has the effect of offsetting this problem. It is to be stressed that such a pollution dilution approach tends to postpone or, in the short term, reduce rather than solve such problems.

Irrigation: In the summer months irrigation demands may be

great enough to warrant augmentation of flow. This is a feature found particularly in the Bow System in dry years when spring runoff is small and irrigation demands in late April, early May and late October exceed the natural capability of the river to meet the demand. Ghost Reservoir is used to meet the spring demand and Lake Minnewanka storage is used to supply the late summer and fall deficiency in flow. Such use may well result in an appreciable drawdown of Lake Minnewanka in August and September.

Domestic and Industrial Supply: In 1971 Bearspaw Reservoir was tapped for the first time for domestic water supply for Calgary. As yet such demands are slight and can be accommodated by natural inflow but this may change in the future. Industrial demand downstream is also met at this time by natural flow, ease of withdrawal being improved by the presence of upstream storage. This also could change in the future and should not be neglected in any area plan.

FAUNA

The study area contains a considerable diversity of wildlife species. Elk (*Cervus canadensis*), Moose (*Alces alces*), Deer (*Cervidae*), and Bear (*Ursidae*) comprise the major percentage of the quadraped group (Soper 1969) and are sufficiently large in numbers to permit seasonal hunting.

Hunting is prohibited in the park areas. However productivity of wildlife, particularly ungulates, is relatively low in the region and both conservation and hunting could be enhanced with positive management. Mule (*Odoccileus hemionus*) and white-tailed deer (*Odocoileus virginianus*) constitute the majority of ungulate population and are plentiful throughout the study area. Moose are also present in sufficient numbers not to warrant protection, only elk seem to need positive management to aid in foothill survival. The number and condition of winter ranges is of vital concern here. Bear, both grizzly (*Ursus horribilis*) and black (*Ursus americanus*) are present and are in no danger of extinction. Fur bearers such as beaver (*Castor canadensis*), and marten (*Martes americana*) are present and smaller species include chipmunks (*Eutamias minimus*), ground squirrels (*Citellus tescorum*), moles (*Microtus spp*) and shrews (*Soricidae spp*). Overall the study area is an important one for wildlife and the resource holds much potential for recreation, especially hunting, fishing and wildlife viewing.

The hydro-electric power reservoirs are located too far west to serve as major breeding or staging grounds for waterfowl, although some are found. Furthermore the large drawdown is not conducive to the formation of good waterfowl habitat. Other less ubiquitous species of bird such as the

osprey (*Pandion haliaetus*) and the golden eagle (*Aquila chrysactos*) find the mountain environment suited to their needs and are potentially a recreational viewing resource. Unfortunately human presence could reduce their survival chances.

Fishing is a popular activity at the reservoirs yielding such species as cutthroat trout (*Salmo clarki*), lake trout (*Salvelinus namaycush*), and rocky mountain whitefish (*Prosopium williamsoni*). It has been found (Miller and Paetz 1959) that species diversity and numbers have fallen since the advent of the reservoirs. This is because low water levels and temperatures inhibit spawning and upstream movement is denied by the dams and low water flow. This need not be so as flow could be supplemented in periods of low flow, and fish ladders provided to aid upstream movement.

Conclusion

The foregoing section has been concerned with the macro-scale physical potential of the study area to support recreation. It was also noted how the resources have demands placed on them for other uses. The following chapter is an attempt to define more closely the potential of the individual reservoirs by considering their micro-scale

physical characteristics and applying demand preferences for individual recreational activities.

Chapter 5

THE RECREATIONAL CAPABILITY OF THE ALBERTA HYDRO-ELECTRIC POWER RESERVOIRS

In order to meet future demand for recreation within a multiple use planning framework it is necessary to classify land according to its recreational capability. This involves going beyond an investigation of the physical resources of the particular region by assigning these resources to particular types of recreational activities. Recreational capability inventories are invaluable aids in such an allocation of physical resources.

THE CANADA LAND INVENTORY FOR OUTDOOR RECREATION

The Canada Land Inventory for Outdoor Recreation (henceforth referred to as the C.L.I. for Recreation) is such a capability classification and was developed under the Agricultural Rehabilitation and Development Act (A,R.D.A.) in 1965 for the purposes of compiling an inventory of natural outdoor recreation resources (C.L.I. 1969). In addition to recreation, the Canada Land Inventory assessed climate, present land use and physical land capability for agriculture, forestry, and wildlife, (C.L.I. 1970 p. 7).

The recreation inventory laid down specific objectives: these were:

- the indication of quality, quantity and distribution of natural recreation resources.
- the indication of the comparative levels of recreational capability for non-urban land, based on present popular preferences.
- the indication of the type of recreation to which the land is best suited.
- the identification of lands and features presenting unique recreational values.
- the provision of basic information to aid governments in the formulation of policies and programs related to their functions of promotion, development and regulation of lands for recreation.
- and to provide a mapping framework within which provinces may gather and record data concerning recreational resources.
[C.L.I. 1969 pp. 3-4]

With these objectives the classification seems ideal to assess the possibilities for recreation at the hydro-electric power reservoirs of Alberta. However, before the classification is described and applied it is necessary to be aware of its inherent limitations.

Firstly and most importantly the very nature of the inventory's operating conditions makes the land classification decisions very subjective. Only limited guidelines were given upon which classes were to be delimited and thus much of the mapping becomes subjective. This problem becomes more exaggerated when different regions

within and outside a province are mapped. Thus it is dangerous to extrapolate various comparative capability areas both within and between regional units.

Secondly it is important to recognise that it is only an inventory of recreational capability and, although it may provide the basis for recreational planning it is not in itself a planning document and should not be treated as such.

Thirdly additional provisions were made in the classification system to provide for an unbiased assessment of the potential of the land for recreation. This involved the application of certain constraints over and above the guidelines drawn up to limit the subjectivity outlined earlier. These additional constraints were:

> Land is ranked according to natural capability under existing conditions whether in natural or modified state... no assumptions are made concerning its capability if it is given further major artificial modifications...
>
> Location and present access development do not influence classification (i.e. perfect market conditions prevail which implies uniform demand and accessibility throughout the inventory area).
>
> Present management factors do not influence ratings except that...land at present firmly committed to intensive urban or industrial use is not normally classified.

> Sound recreation land management and development practices are assumed for all areas in practical relation to the natural capability of each.
>
> (C.L.I. 1969, pp. 6-7)

These guidelines are the basis of classification and have been summed up as being " _the quantity of recreation which may be generated and sustained per unit area of land per year under perfect market conditions_." (C.L.I. 1969 p. 7).

When planning recreational resource development it is necessary to relax these constraints and include such features as location, access, facility use and development and management policies. Sound comprehensive planning can then follow. With regard to the hydro-electric reservoirs of Alberta, these features will be evaluated in chapter six.

Given such limitations, it was decided to use the C.L.I. recreation classification scheme. A number of reasons influenced this choice but the existence of inventory data for many of the reservoirs was the principal factor. Anderson (1967) used the C.L.I. recreation classification in an applied study on the comparison between capability and access. He pointed out its universality, its development by highly regarded recreation workers and its simplicity of application and analysis. This is in contrast to other classifications which tend to be oversimplified or too complex for meaningful analysis.

THE CLASSIFICATION SCHEME

Nowicki (1969), in a study on the recreational capability of lakes in Central Alberta, devoted considerable attention to the operating procedures of the C.L.I. for recreation (Nowicki 1969 pp. 1-29). Since then a more recent report (C.L.I. Report No. 6. 1969) has been produced. This report clarified the objectives and operating procedures of the classification. Corbett (1973) in another study of recreational capability discussed these revisions at length and demonstrated their method of application. Thus the outline presented here is only a brief summary of the objectives of the classification scheme. A more detailed description can be found in the literature noted above.

According to the C.L.I. for recreation, land being assessed for recreational purposes is divided into two broad subdivisions: upland and shoreland.

> "Shoreland is a broad term embracing the various components of land fronting on a water body which is either capable of supporting recreational activity or is large enough to do so. In practise, water bodies capable of supporting family boating are considered necessary for shoreland designation."
>
> (C.L.I. 1969 p. 10)

It should be noted that this feature controls the number of reservoir sites studied. Thirteen hydro-electric power sites exist in Alberta but only nine have significant storage to permit recreation activity.

"Shoreland extends from the 5-foot depth contour at normal low water, inland from the shoreland to a natural boundary, or to a boundary which encompasses the direct zone of influence of the water body. In this inventory the zone of influence is assumed to reach a maximum of one mile in width for a class one unit on a large lake: other shoreland units will vary in width from about 800 feet...to one mile depending on the nature of the shoreland and on its capability for recreation...shoreland components are defined as follows.

a) wet beach: the area of beach below the normal high water line, usually outward to the 5-foot depth contour at normal low water.

b) dry beach: the area of beach above the normal summer high water or high tide level but normally subject to wash by high water or storm waves.

c) beach: the width of the shore zone which includes the wet and dry beaches.

d) backshore: that part of the shoreland reaching inland from the dry beach normally as far as the extreme extent of storm action or ice erosion. For the purposes of this inventory however backshore refers to the zone of influence of the water body embracing the associated development area...

Upland is all land other than shoreland."
(C.L.I. 1969 pp. 110-111)

The actual water surface area of the reservoirs is not part of the capability assessment but the land area immediately adjacent to the reservoir in all cases is designated shoreland.

From this general rating, land is then rated according to a predetermined set of conditions and placed on a rating scale of Class 1 to Class 7.

Class	Rating
1	very high
2	high
3	moderately high
4	moderate
5	moderately low
6	low
7	very low

Unfortunately it is only in the case of shoreland suitable for bathing beaches [see sub-classes below] that strict rating guidelines are laid down.

The final stage in the inventory is to assign to the shoreland or upland class rating three of a possible twenty-five recreational activities that could be pursued at the particular inventory site.

> 'There are twenty-five recreational features which represent the major uses of land for recreation as indicated by present popular preferences.'
> [C.L.I. 1969, p. 10]

These recreational features are:

	Symbol		Activity
Sub-class	A	=	angling
"	B	=	family boating
"	C	=	canoeing
"	D	=	deep water boating
"	E	=	vegetation appreciation
"	F	=	waterfall viewing
"	G	=	glacier
"	H	=	historic site visiting
"	J	=	collecting
"	K	=	camping
"	L	=	landform viewing
"	M	=	small stream
"	N	=	lodging
"	O	=	upland wildlife viewing
"	P	=	cultural landscape appreciation
"	Q	=	aesthetic appreciation while hiking.

"	R	=	rock formation viewing
"	S	=	skiing
"	T	=	thermal springs enjoyment
"	U	=	yachting
"	V	=	scenic viewing
"	W	=	waterfowl viewing
"	X	=	miscellaneous
"	Y	=	boating
"	Z	=	viewing man-made structures (see Table 5)

(C.L.I. 1969 p. 114)

Thus the three applicable recreational features chosen from this list are combined with the class rating to indicate the site's complete recreational capability:

> "The opportunities for recreation provided by a feature or combination of features, and assessed in terms of <u>quantity</u> of use, determine the class of land unit. Although the recreational features are described individually it is the exception rather than the rule that a land unit is ranked on the strength of a single feature. The class of a unit depends on the total quantity of recreation which the particular association of features within the land unit is judged capable of generating per unit area on an annual basis..."
>
> (C.L.I. 1969, p. 10)

The resulting assessment is mapped at a scale of 1:50,000 by using the symbols shown in the above chart. As an example a land unit of 2SNBY (or written 2SB) would indicate a Class 2 shoreland unit (S) suitable for cottaging (N) (and thus, it is argued, suitable for camping but not vice-versa) with a bathing beach (B) and water suitable for popular forms of family boating (Y). Similarly an upland (U) with a 6UVLR notation would offer the capability for dispersed recreational use with the terrain offering

opportunity for scenic viewing (V) and a chance to see interesting landform (L) and rock (R) formations.

Field Procedures

C.L.I. recreation maps at scales of 1:50,000 and 1:250,000 existed for all the hydro-electric power reservoirs except Lake Abraham, Lake Minnewanka, Spray Reservoir, Upper and Lower Kananaskis Lakes and Barrier Reservoir. In the case of Spray Reservoir, Upper and Lower Kananaskis Lakes and Barrier Reservoir mapping had only been done at a scale of 1:250,000. Nevertheless this scale was adequate for evaluating recreational capability. Lake Abraham had to be mapped at a scale of 1:50,000 as the recency of its formation meant that it did not exist at the time of the province-wide C.L.I. recreation inventory of 1967. Lake Minnewanka had also to be mapped as areas under National Parks jurisdiction had been excluded at the time of the first inventory.

Evaluation

It is proposed to evaluate each hydro-electric power reservoir in turn using the C.L.I. recreation maps, but ignoring the questions of access, availability of other sites and management policies for the present. These

features are discussed in chapter six.

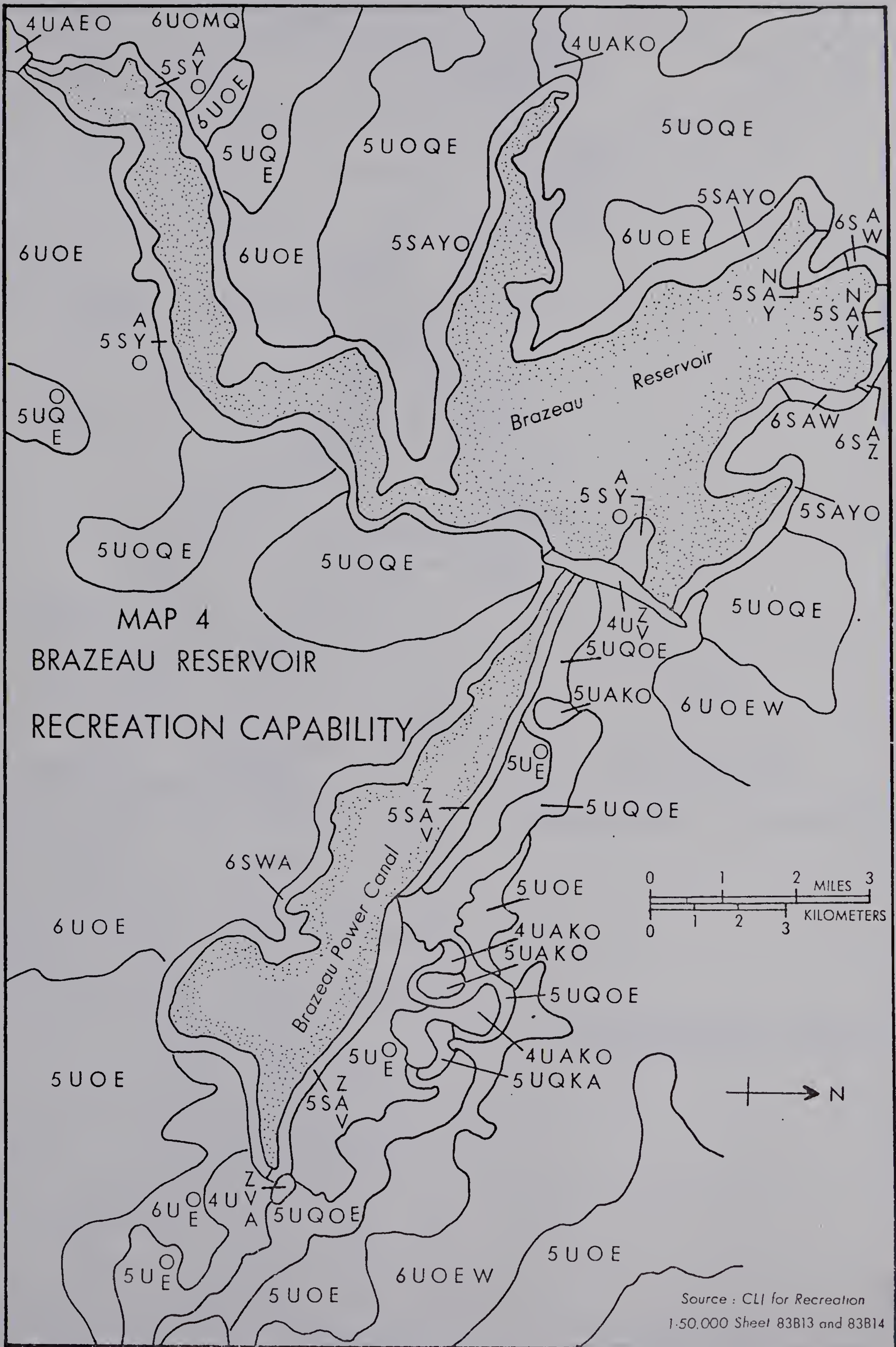
North Saskatchewan System

Brazeau Reservoir

From Table 5 and Map 4 it can be seen that of the shoreland, for only 1/4 of a mile around Brazeau reservoir can recreation capability be rated higher than Class 5. Ironically this more capable area is on the man-made embankment for the dam. Elsewhere Class 5 land predominates. The recreation activities assigned to the Class 5 and Class 6 lands are non-intensive, being mainly angling, family boating and wildlife observation. This low capability to support intensive recreation is continued into the upland areas. Furthermore the upland has no special attributes such as scenic viewing which would have enhanced the recreation potential of the reservoir. Thus based upon C.L.I. recreation classification, Brazeau has a low capability for recreation.

Lake Abraham

Lake Abraham has a greater potential for recreational use than Brazeau Reservoir because of higher C.L.I. recreation ratings and a greater diversity of recreational opportunities (Map 5. Table 5). The greater part of the shoreland is rated Class 3 but there is a high percentage of


MAP 4
BRAZEAU RESERVOIR
RECREATION CAPABILITY
Brazeau Reservoir
Brazeau Power Canal
4UAEO
6UOMQ
5SYAO
6UOE
5UQOE
5UOQE
5SAYO
4UAKO
6UOE
5SAYN
5SAW
6SAW
6SAZ
5SYAO
5UQOE
4UZV
5UQOE
5UAKO
6UOEW
5UOE
5SAZV
6SWA
5UOE
4UAKO
5UAKO
5UQOE
4UAKO
5UQKA
6UOE
5UOE
4UZVA
5UQOE
5UOE
6UOEW
0 1 2 3 MILES
0 1 2 3 KILOMETERS
N
Source : CLI for Recreation
1:50,000 Sheet 83B13 and 83B14

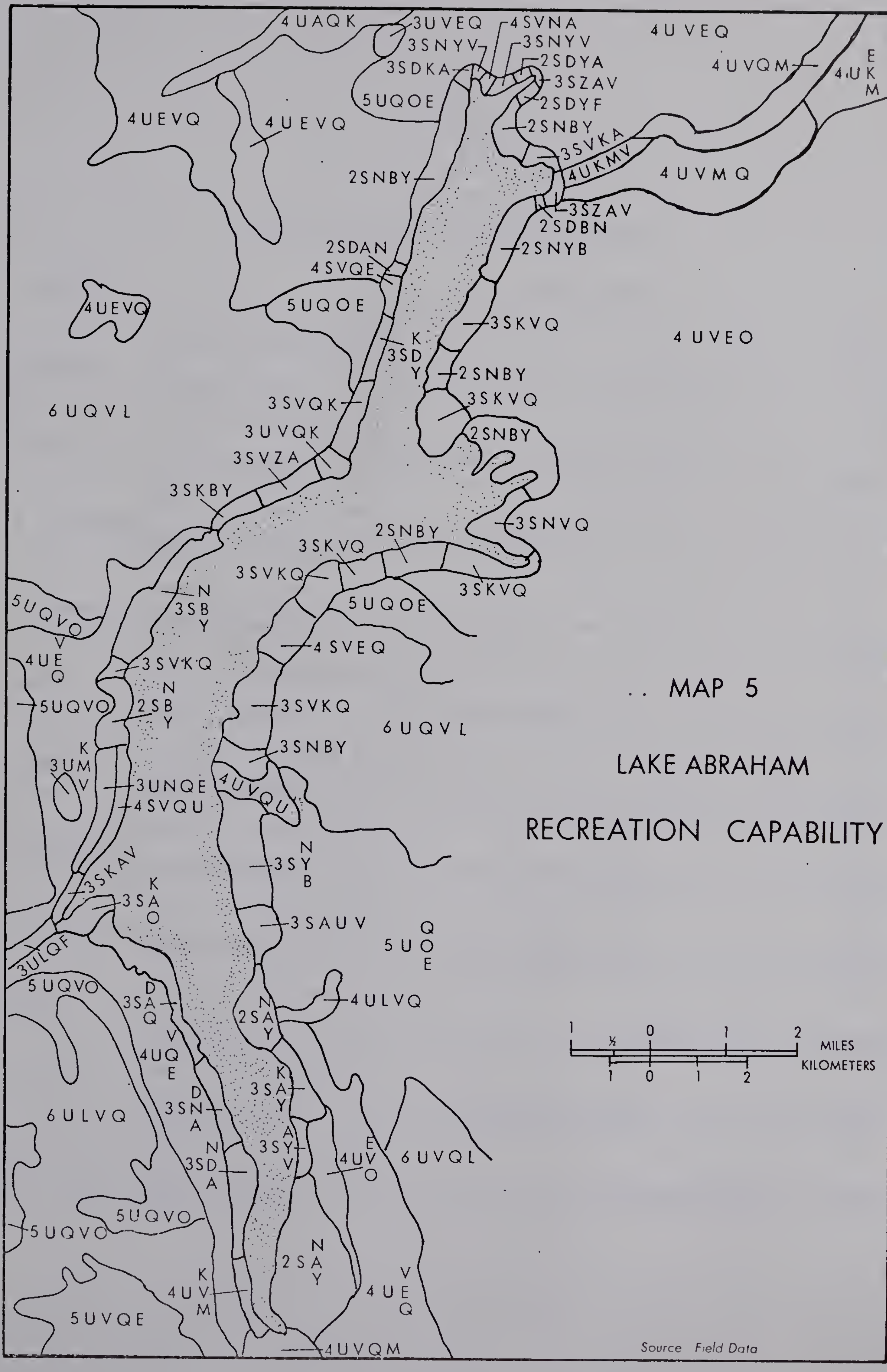

MAP 5
LAKE ABRAHAM
RECREATION CAPABILITY
MILES
KILOMETERS
Source Field Data
4UAQK
3UVEQ
4SVNA
3SNYV
3SDKA
2SDYA
3SZAV
2SDYF
5UQOE
4UEVQ
2SNBY
3SVKA
4UKMV
4UVMQ
4UVEQ
4UVQM
2SDBN
2SNYB
2SDAN
4SVQE
3SKVQ
4UVEO
6UQVL
3SVQK
3UVQK
3SVZA
3SKBY
3SNVQ
3SVKQ
5UQVO
4SVEQ
3SNBY
3UNQE
4SVQU
4UVQU
3SKAV
3SAUV
3ULQF
4ULVQ
6ULVQ
6UVQL
5UVQE

TABLE 5

CANADA LAND INVENTORY DATA
FOR THE
HYDROELECTRIC POWER RESERVOIRS OF ALBERTA

RESERVOIR		CLASS OF UNIT 1	2	3	4	5	6	7	TOTAL
BEARSPAW	Number of Shoreland Units				6	2			8
	Shoreline Miles				9.53	1.17			10.70
GHOST	Number of Shoreland Units			1	12	9			22
	Shoreline Miles			0.78	11.21	8.40			20.39
U. KANANASKIS	Number of Shoreland Units		8	1					9
	Shoreline Miles		7.2	0.9					8.1
L. KANANASKIS	Number of Shoreland Units		3						3
	Shoreline Miles		13.8						13.8
SPRAY	Number of Shoreland Units		7	6	3				16
	Shoreline Miles		14.3	13.0	7.3				34.6
BARRIER	Number of Shoreland Units					10			10
	Shoreline Miles					8.4			8.4
L.MINNEWANKA	Number of Shoreland Units		25	42	28				95
	Shoreline Miles		8.2	9.23	8.36				25.79
L. ABRAHAM	Number of Shoreland Units		12	32	5				49
	Shoreline Miles		13.1	26.43	3.01				42.54
BRAZEAU	Number of Shoreland Units				1	5	3		9
	Shoreline Miles				1.8	49.83	3.12		54.75
TWO JACK LK.	Number of Shoreland Units		1	2	3				6
	Shoreline Miles		2.25	0.25	0.40				2.9
BRAZEAU P.C.	Number of Shoreland Units				1	1	1		3
	Shoreline Miles				0.25	9.10	13.03		22.38

Class 2 land. Most of the Class 2 land is situated at the northern end of the lake with many 2SNBY units present indicating the higher quality of some shoreland sites for lodging, bathing and family boating. Of lesser quality but still Class 2 are the potential deep-water boat launch areas situated at the north end of the lake. They are situated close to the access road to the dam and are a result of excavation for the dam presenting smooth gradients into the water. The southern Class 2 sites occupy good cottaging shoreland with associated angling and boating opportunities.

The Class 3 shoreland is the most common unit and is found along all the reservoir shoreland. The recreation activities possible vary from cottaging to the less discriminating camping, boating and angling. At the northern end of the lake scenic viewing is an important possible activity with the particular site affording a view of the lake and the surrounding upland (Plate 12).

Shoreland areas designated Class 4 are small in extent and are confined to the steeply sloping land close to the water limit. Possible recreational opportunities include cottaging , camping, scenic viewing and aesthetic appreciation of the natural environment while hiking.

The surrounding upland is dominated by Class 4 land in the foothills and Class 6 in the front ranges. The nature of

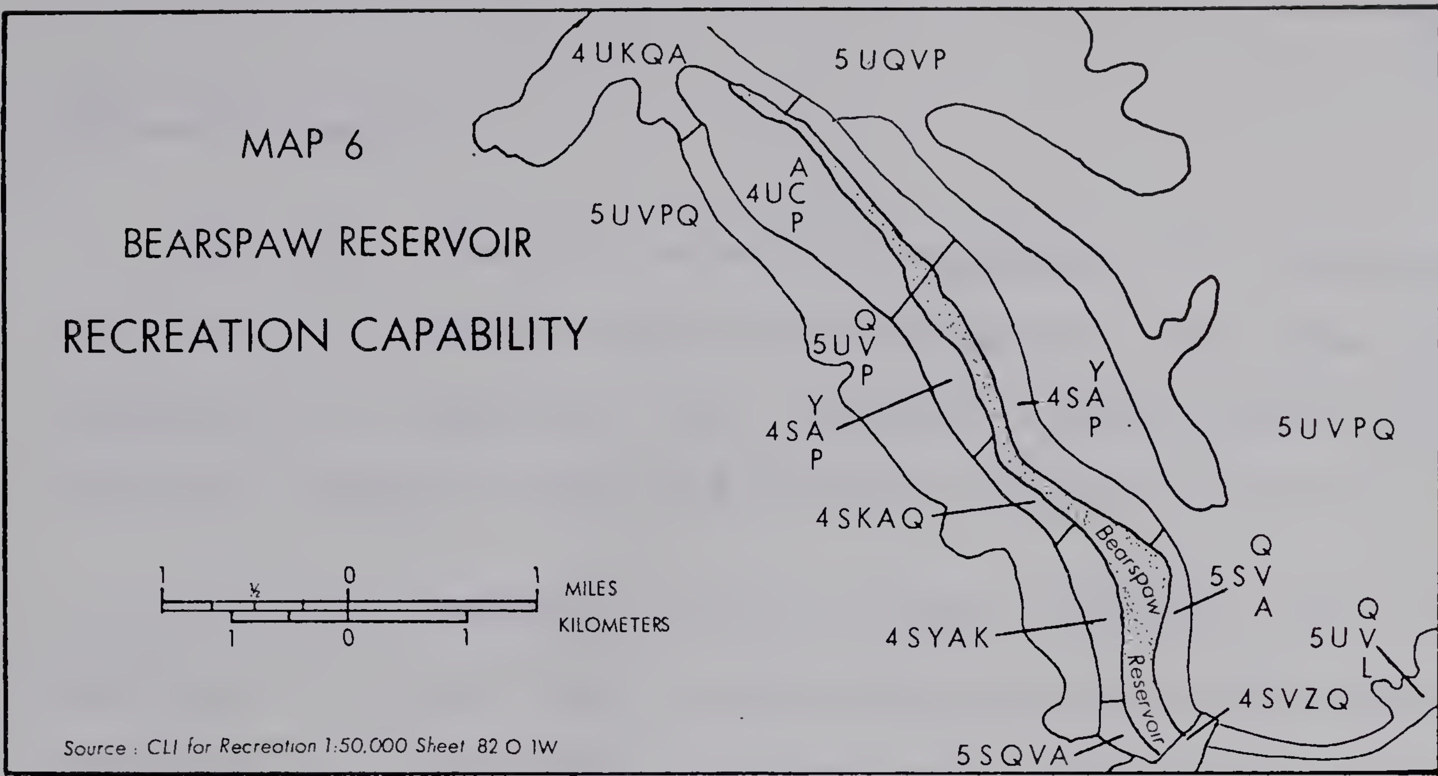
the upland has given it good potential for extensive recreational pursuits such as scenic viewing, appreciation of vegetation, aesthetic enjoyment of the natural environment by such pursuits as hiking, and occasionally the chance tc see interesting landforms.

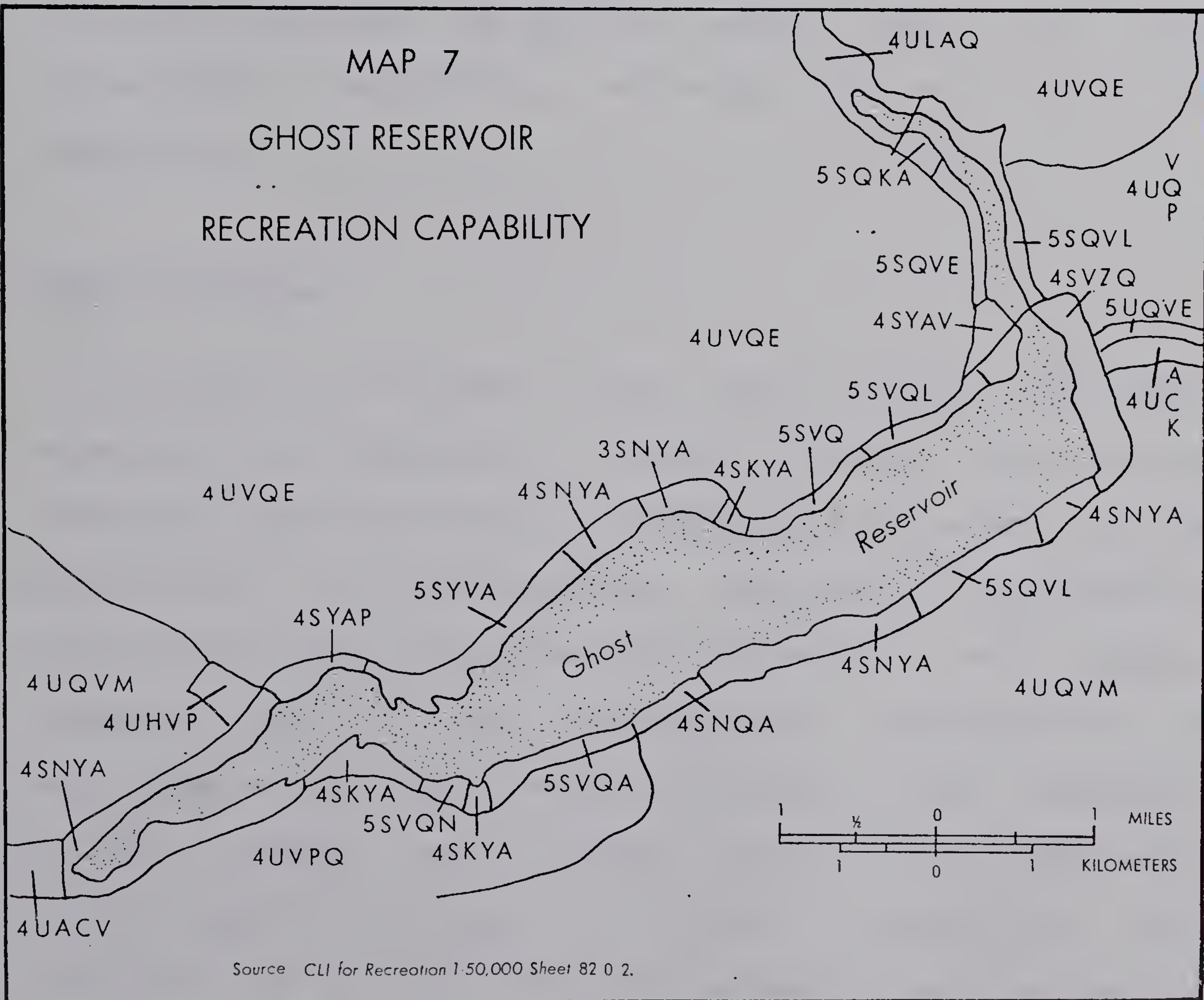
In total the possibilities for recreation according to the C.L.I. for Recreation are good, with a high diversity of possible recreation activities and a pleasing mixture of upland and shoreland areas.

Bow River System

Bearspaw Reservoir

In Map 6 the recreational capability of the reservoir according to the C.L.I. is shown and in Table 5 the extent of the shcreland units is indicated in miles. The capability classification shows a predominance of Class 4 shoreland owing to the lack of beach area and the steep backshore. This has meant that the possibilities for recreation are limited to such activities as angling, scenic viewing, and in some cases camping. On the south shore cf the reservoir there is an area where boat-launching is possible. When evaluated in regard to the prcximity of the site to an urban complex such areas as these become very important for recreaticn. Such considerations will be discussed in the


MAP 6
BEARSPAW RESERVOIR
RECREATION CAPABILITY
4UKQA
5UQVP
5UVPQ
4UCAP
5UVQP
4SAYP
4SAYP
5UVPQ
4SKAQ
5SVQA
4SYAK
5UVQL
4SVZQ
5SQVA
Bearspaw Reservoir
MILES
KILOMETERS
Source : CLI for Recreation 1:50,000 Sheet 82 O 1W


MAP 7
GHOST RESERVOIR
RECREATION CAPABILITY
4ULAQ
4UVQE
5SQKA
4UQVP
5SQVL
5SQVE
4SVZQ
5UQVE
4SYAV
4UVQE
4UCAK
5SVQL
5SVQ
3SNYA
4SKYA
4UVQE
4SNYA
Reservoir
4SNYA
5SQVL
5SYVA
4SYAP
Ghost
4SNYA
4UQVM
4UQVM
4UHVP
4SNQA
4SNYA
5SVQA
4SKYA
5SVQN
4UVPQ
4SKYA
MILES
KILOMETERS
4UACV
Source CLI for Recreation 1:50,000 Sheet 82 0 2.

following chapter.

The only Class 5 area is backshore of a steeper gradient at the eastern end of the reservoir. This area is classified as suitable for aesthetic appreciation of the landscape, scenic viewing and angling (Plates 13 and 14).

The upland consists of the river terraces and the plains and is rated Class 5, fit only for such non-intensive activities as landscape viewing and appreciation. Thus Bearspaw Reservoir is not a water body with high recreational capability, according to the C.L.I. for recreation.

Ghost Reservoir

In Map 7 and Table 5 it can be seen that Ghost Reservoir is dominated by Class 4 land. There is one shoreland area rated Class 3, situated in the middle of the north shore of the reservoir. This area is suggested as being suitable for cottaging, boat launching, and angling. Otherwise Class 4 land predominates. Possibilities for recreation on this land include cottaging, boat launching, angling, camping, scenic viewing, nature appreciation while hiking, and even the chance to visit a historical site. Cottaging is the most important potential use, followed by appreciation of topographic variety while hiking, boating

and scenic viewing.

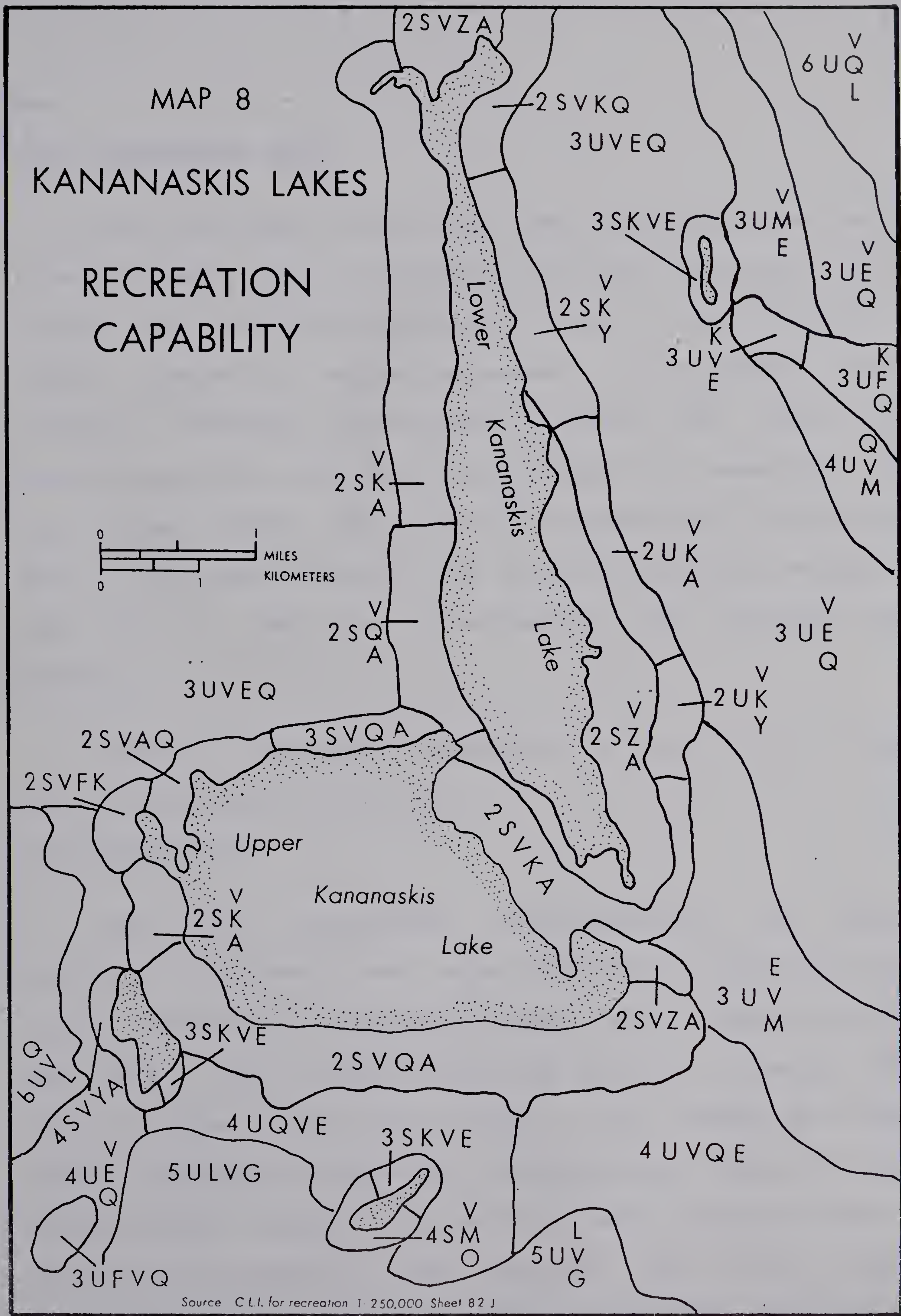
The Class 5 areas are smaller in area and are a result of a steeper backshore. They have the same range of recreational possibilities as the Class 4 land (Plate 15).

The upland is generally Class 4 and could support scenic viewing, vegetation appreciation and hiking. Thus, according to the C.L.I. for recreation, the potential for recreation at Ghost Reservoir is generally favourable but the reservoir has no shoreline area with a high capability.

Upper Kananaskis Lake

In Map 8 and Table 5 the high recreational capability of this reservoir is shown. Most of the shoreland is rated Class 2. Some Class 3 shoreland exists on the north shore, resulting from a slightly steeper backshore. The capability classification sub-classes are of a passive nature. Scenic viewing is the first sub-class at all shoreland units. Camping or nature appreciation are always the second sub-class, while angling is always the third sub-class.

Recreational opportunities for the surrounding upland reflect the scenic nature of the area and the upland is classified as suitable for scenic viewing, hiking, nature appreciation, interesting landforms and glacier viewing. The Class 5 or 6 rating indicates the low intensity of possible


MAP 8
KANANASKIS LAKES
RECREATION CAPABILITY
MILES
KILOMETERS
0
1
0
1
Lower Kananaskis Lake
Upper Kananaskis Lake
2SVZA
2SVKQ
3UVEQ
6UQ
V
L
3SKVE
3UM
V
E
3UE
V
Q
2SK
V
Y
3UV
K
E
3UF
K
Q
4UV
Q
M
2SK
V
A
2UK
V
A
2SQ
V
A
3UE
V
Q
3UVEQ
2UK
V
Y
3SVQA
2SZ
V
A
2SVAQ
2SVFK
2SVKA
2SK
V
A
E
3UV
M
2SVZA
3SKVE
2SVQA
6UV
Q
L
4SVYA
4UQVE
3SKVE
4UVQE
4UE
V
Q
5ULVG
4SM
V
O
5UV
L
G
3UFVQ
Source C.L.I. for recreation 1:250,000 Sheet 82 J

use.

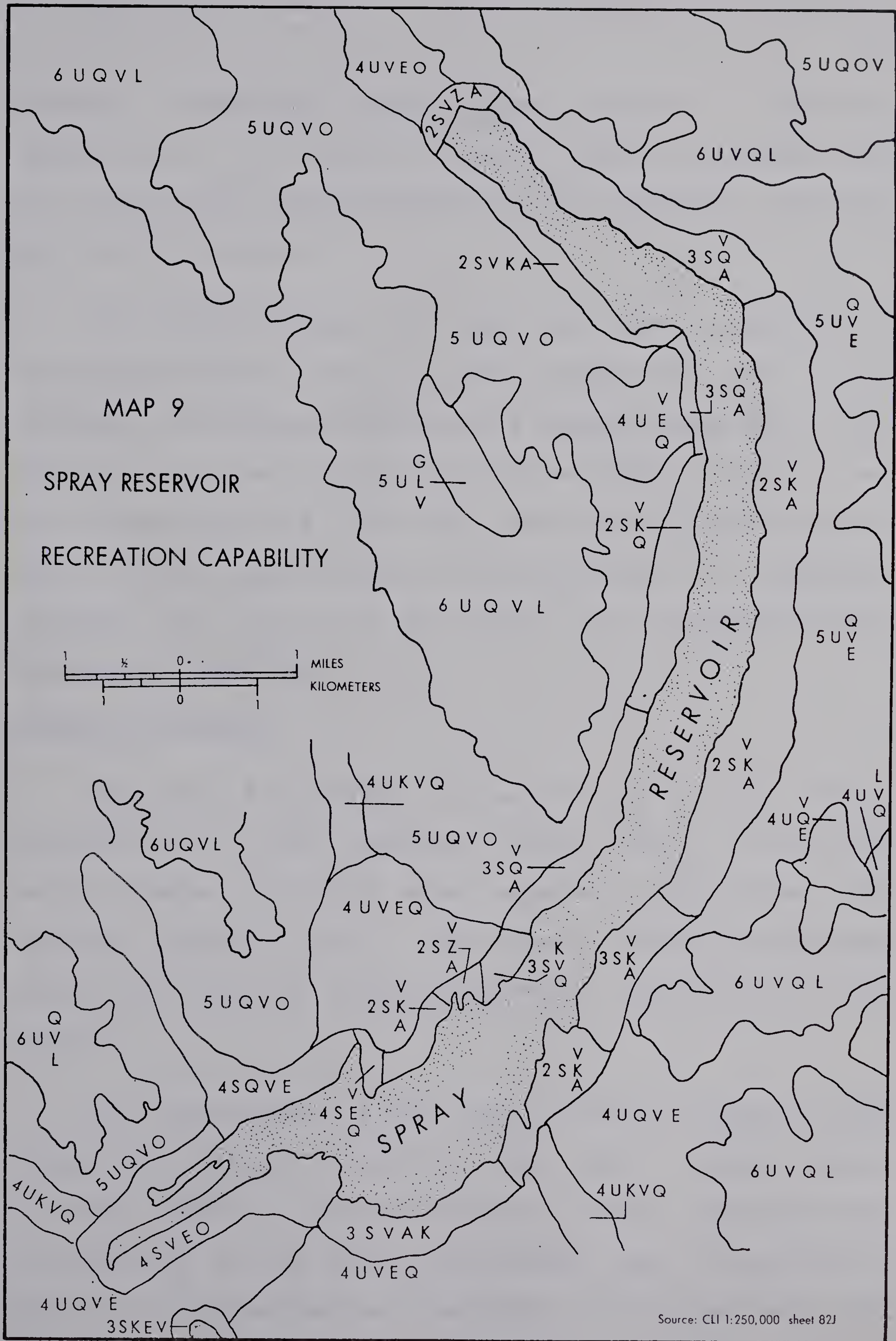
Lower Kananaskis Lake

Map 8 and Table 5 show that Lower Kananaskis Lake has a higher capability for recreation than Upper Kananaskis Lake because all of the shoreland is Class 2. For sub-classes, scenic viewing is again paramount in importance with camping, landscape appreciation, hiking and angling of lesser importance. The surrounding upland is comparable to that around Upper Kananaskis Lake except that on the east side of the lower reservoir the slope has lessened enough to rate Class 3. This is an extensive area suitable for camping.

Overall, recreation potential is very high at both lakes, according to the C.L.I.

Spray Reservoir

The C.L.I. recreation classification for Spray Reservoir indicates much more diversity in class and sub-class, than the two Kananaskis Lakes. This is shown in Map 9 and Table 5. This is due to the dams causing a reservoir of arcuate shape within the valley. This results in a more varied shoreland topography. Nevertheless Class 2 land predominates, Class 3 is next and small areas of Class 4 land are to be found at the southwest end of the lake. Scenic viewing is again of primary importance, followed by


MAP 9
SPRAY RESERVOIR
RECREATION CAPABILITY
MILES
KILOMETERS
SPRAY
RESERVOIR
6UQVL
4UVEO
5UQOV
2SVZA
5UQVO
6UVQL
2SVKA
3SQVA
5UVQE
5UQVO
3SQVA
4UVEQ
5ULGV
2SKVA
2SKVQ
6UQVL
5UVQE
2SKVA
4UKVQ
4UVLQ
4UQVE
6UQVL
5UQVO
3SQVA
4UVEQ
2SZVA
3SVKQ
3SKVA
6UVQL
2SKVA
5UQVO
6UVQL
2SKVA
4SQVE
4SEVQ
4UQVE
5UQVO
6UVQL
4UKVQ
4UKVQ
4SVEO
3SVAK
4UVEQ
4UQVE
3SKEV
Source: CLI 1:250,000 sheet 82J

camping, landscape appreciation, hiking, vegetation appreciation and wildlife viewing. Angling, although often the third choice for sub-class, is an important potential use for the reservoir.

The upland rating is much the same as that for the Kananaskis Valley: Class 6 land predominates with scenic viewing, interesting landforms and nature appreciation while hiking as the major sub-classes. Some Class 5 land is found where the slopes are less steep. Thus Spray Reservoir can be seen to have a high potential for many forms of recreation although the area has not such a high capability as the Kananaskis Lakes area.

Barrier Reservoir

From Map 10 and Table 5 it can be seen that Barrier Reservoir has only shoreland rated Class 4. Camping and scenic viewing are the most important sub-classes with angling important as a third choice. Limited opportunity exists for wildlife, viewing and nature appreciation while hiking.

The surrounding upland has a Class 6 rating at high levels and a Class 5 rating on the lower slopes. Scenic viewing, hiking, upland wildlife viewing and vegetation appreciation are the major sub-classes. Thus, according to the C.L.I. for Recreation capability, is only moderate. Such

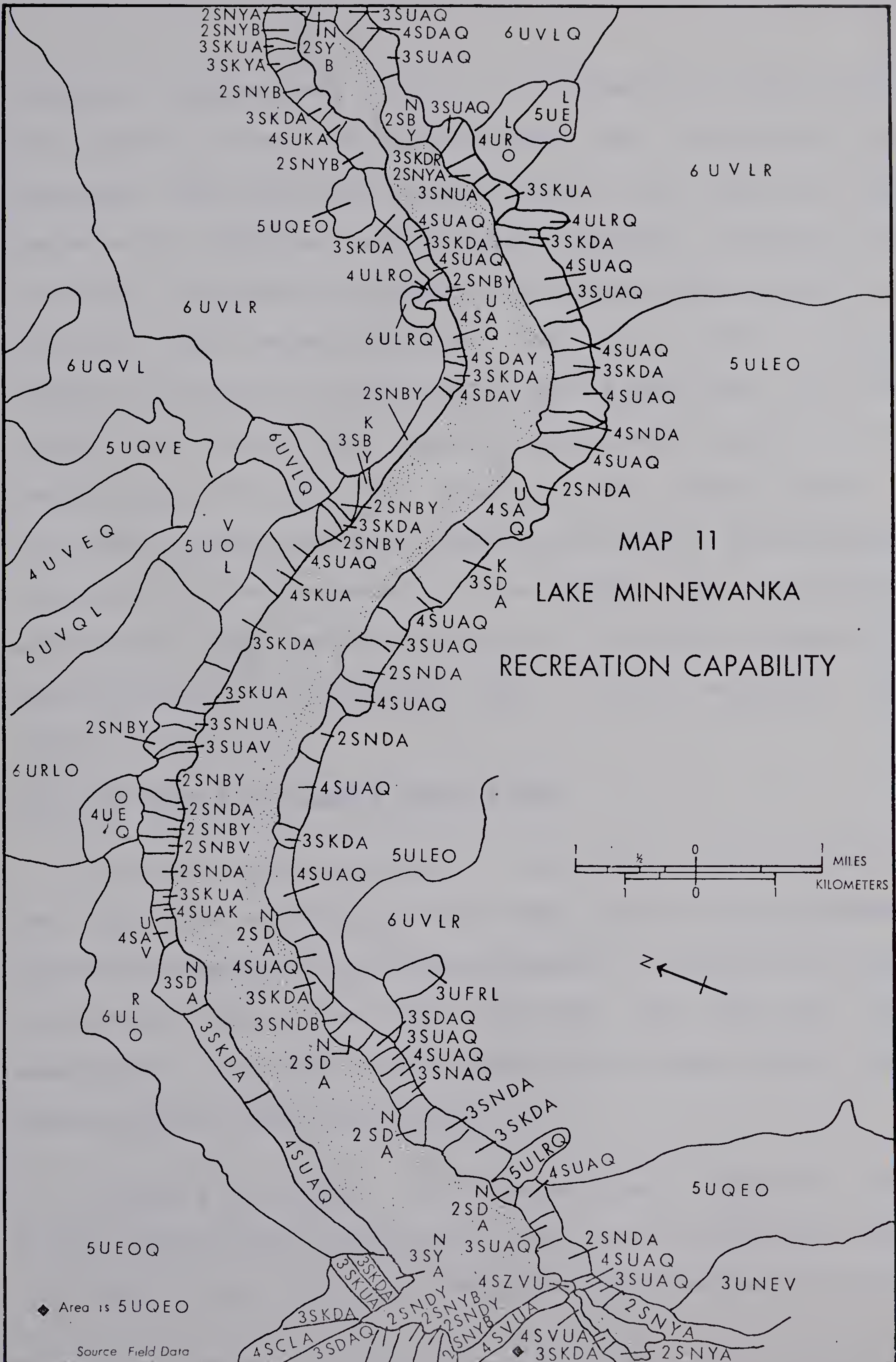

MAP 10
BARRIER RESERVOIR
RECREATION CAPABILITY
1 ½ 0 MILES 1
1 KILOMETES 1
RESERVOIR
BARRIER
4 U V Q A
4 U V K A
4 S V K A
4 S V Z A
4 S V Q A
4 S V K A
5 U Q O V
4 U V Q O
4 S V K Q
4 S V Q A
5 U Q V O
4 S V L Q
4 S V K A
4 S V K A
6 U Q V O
6 U O V L
4 S V A O
Source : CLI for Recreation 1:250,000 sheet 82J

an assessment seems harsh. The lower part of the Kananaskis Valley has more abundant wildlife than the upper valley and the reservoir is quite photogenic. Moreover the quantity of use this reservoir could sustain appears fairly high.

<u>Lake Minnewanka</u>

In Map 11 and Table 5 the diverse recreational capability of the Lake Minnewanka shoreline is shown. Although only three classes are represented, Classes 2, 3 and 4, there exists a multitude of possible recreation activities. A pattern exists of a steeply slcping backshore (Class 4) that is only suitable for deep water boating, angling and hiking. In places camping is possible but the area is limited. Where this backshore flattens, the shoreland is upgraded to a Class 3 rating with camping more widespread but with deep water boating, angling and hiking still the major sub-classes. The shoreland capability rating is further upgraded to Class 2 where the land is very flat. This is usually the site of a fan or delta built out from the canyons and creeks in the upland. Possible recreational opportunities change to cottaging, boat launching and in some cases beaches. However the beach areas tend to be very small in area (Plate 16).

The upland is the most diverse of all the reservoirs. Generally the upland is very scenic but unable to support


MAP 11
LAKE MINNEWANKA
RECREATION CAPABILITY
1 ½ 0 1 MILES
1 0 1 KILOMETERS
N
Area is 5UQEO
Source Field Data
6UVLQ
6UVLR
5UEO
4URO
5ULEO
6UQVL
5UQVE
6UVLQ
4UVEQ
5UOVL
6UVQL
6URLO
4UEOQ
5UQEO
6UVLR
3UFRL
6ULRO
5UEOQ
5ULRQ
5UQEO
3UNEV
4ULRQ
4ULRO
6ULRQ
2SNYA
2SNYB
3SKUA
3SKYA
3SUAQ
4SDAQ
3SKDA
4SUKA
3SKDR
3SNUA
4SUAQ
2SNBY
4SDAY
4SDAV
4SNDA
2SNDA
3SBKY
4SAUQ
3SDKA
3SUAV
2SNBV
4SUAK
4SAUV
2SDNA
3SDNA
3SNDB
3SDAQ
3SNAQ
3SNDA
3SYNA
4SZVU
2SNDY
4SCLA
3SDAQ
4SVUA

intensive recreation. Class 6 is suggested for the peaks with scenic viewing and interesting rock formations and landforms the major sub-classes. Class 5 land exists on the slopes with landform appreciation, wildlife viewing and vegetation enjoyment the major sub-classes. This pattern is broken by deep scenic canyons that rate Class 4 with landform appreciation, interesting rock formations, wildlife viewing and hiking in a natural environment the major sub-classes (Plate 17). At one point on the south shore a waterfall becomes the focal point of interest. This further indicates the diverse nature of the upland for recreation activities. Thus, based on the C.L.I. recreation capability classification Lake Minnewanka has a high capability to support recreation.

Two Jack Lake and Brazeau Power Canal

Reference should be made at this point in the thesis to Two Jack Lake and Brazeau Power Canal, which act as pondage for Lake Minnewanka and Brazeau Reservoir respectively. Both are situated below the main reservoir but both act as reservoirs, and would not be present if it were not for the hydro-electric power development.

In Map 4 and Table 5 the recreational capability of Brazeau Power Canal according to the C.L.I. is indicated and in Table 5 the area and shoreline length of the canal is

shown. Recreational capability is low on the south-west shore (6SWA) owing to the presence of muskeg. On the north-east shore where a gravel bank has been constructed the shoreland recreational capability rises to Class 5. Viewing man-made structures, angling and scenic viewing are the only sub-classes. To the north-east of the power canal and within the former channel of the Brazeau River camping is important. Also angling would have been possible before the installation of the dam which diverted flow from the channel. Overall recreational capability is low according to the C.L.I.

Two Jack Lake has a high capability for recreation. Two and 1/4 miles of the shoreland area are classified 2SNYA (Table 5). This indicates a shoreland site capable of supporting a high intensity of recreational use and suited to all forms of lodging, family boating and angling (Map 11). The remaining sites are either Class 3 or Class 4 and suitable for scenic viewing, deep-water boating, viewing man-made structures, angling or aesthetic appreciation of the environment while hiking. The surrounding upland is rated Class 3 and Class 5 and suitable for scenic viewing, upland wildlife observation and recreational use of interesting vegetation.

Conclusion

The recreational evaluations noted above show the wide variety cf recreationally capable land existing around the hydro-electric power reservoirs of Alberta. The inventory indicates that while most of a reservoir shoreline is suitable for some form of recreational use, not all of it can absorb intensive development. It can be assumed that areas in Classes 5 and 6 can withstand only a low total annual use and should not be considered suitable for large-scale development, except in exceptional circumstances, or unless major modification is undertaken. Thus reservoirs such as Brazeau immediately fall into a subordinate position with regard to future recreational development. There are no Class 1 areas on any of the hydro-electric power reservoirs and therefore Class 2 areas, such as those on the two Kananaskis Lakes, become of primary importance. Any comprehensive plan to increase the recreational opportunities in the eastern slopes of Alberta should centre around such recreationally capable areas if possible..

Before the hydro-electric power reservoirs can be considered as safety valves for future recreational pressure, present characteristics and facility use, assessibility and land management possibilities have to be considered. Also other resource users may have legitimate

claims to the resources of the area. If such claims are strong enough it is even possible that sub-optional recreation land, that is Classes 3 and 4, will be used to alleviate pressure. Such vital considerations will be important subjects in the next chapter.

Chapter 6

LAND USE AT THE HYDRO-ELECTRIC POWER RESERVOIRS OF ALBERTA

In the preceding chapter, land capability for recreation at the hydro-electric power reservoirs was evaluated using the Canada Land Inventory. To use this classification, certain constraints had to be applied. In this chapter it is proposed to relax these constraints and the development possibilities for recreation can then be fully evaluated. The constraints to be relaxed are those of current recreation facilities, access and management development and practise. All of these could have an effect on the recreation potential of the hydro-electric power reservoirs. Also in this chapter it is proposed that other resource uses be described and evaluated for these uses could influence the development of recreation in the area. In this way most of the relevant data required for suggesting viable development possibilities for the hydro-electric power reservoirs of Alberta will be provided.

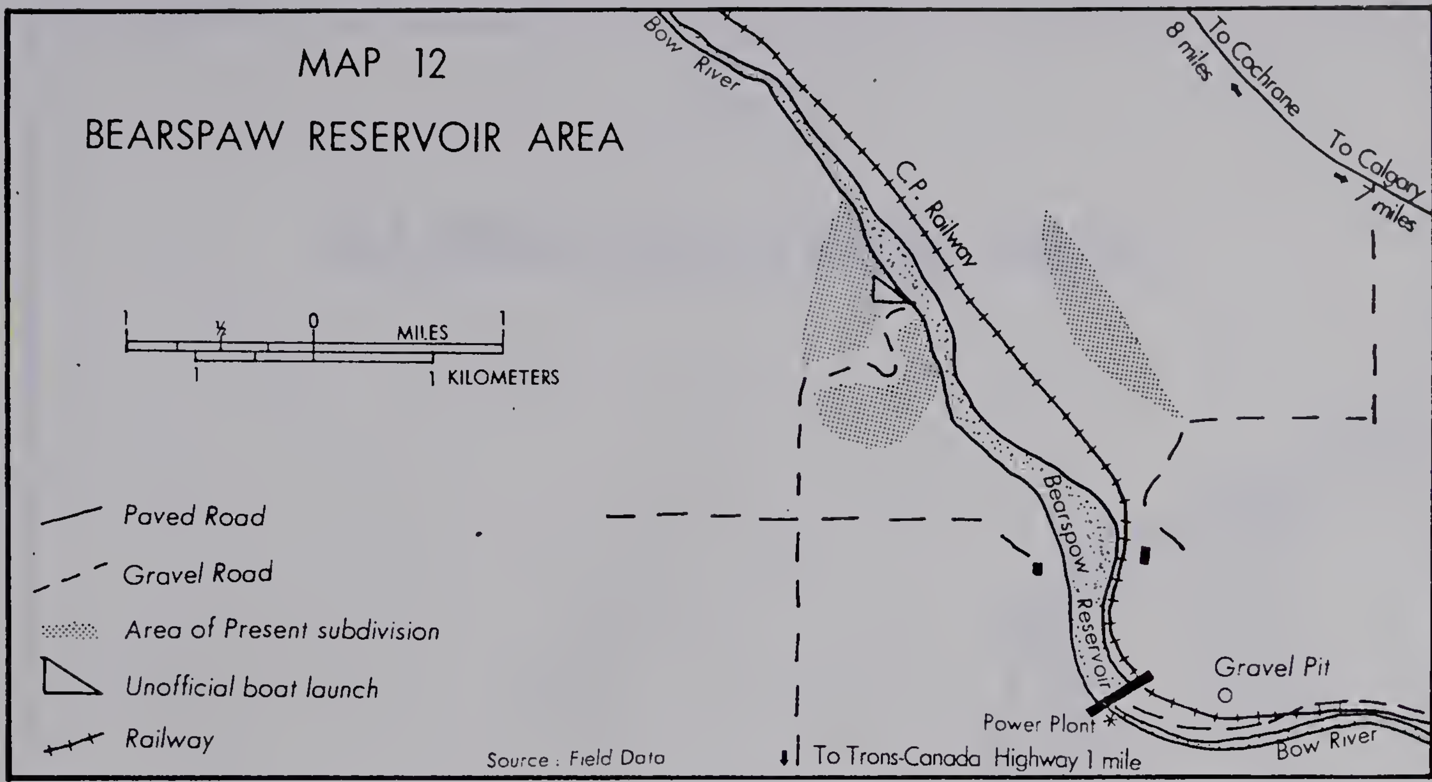
Current Recreation Facilities

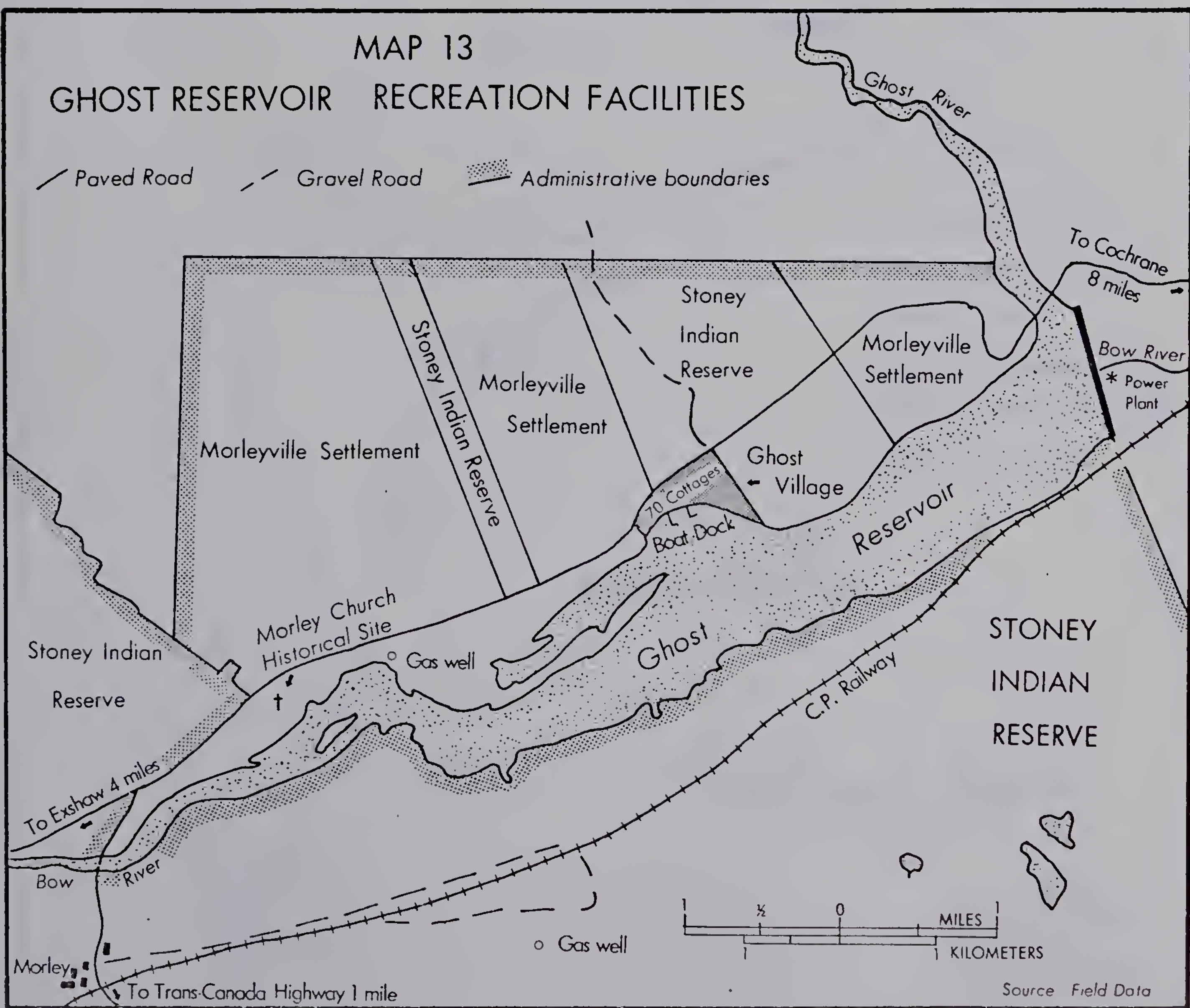
The recreation facilities of an area should reflect the capability of that area to support recreation. Furthermore

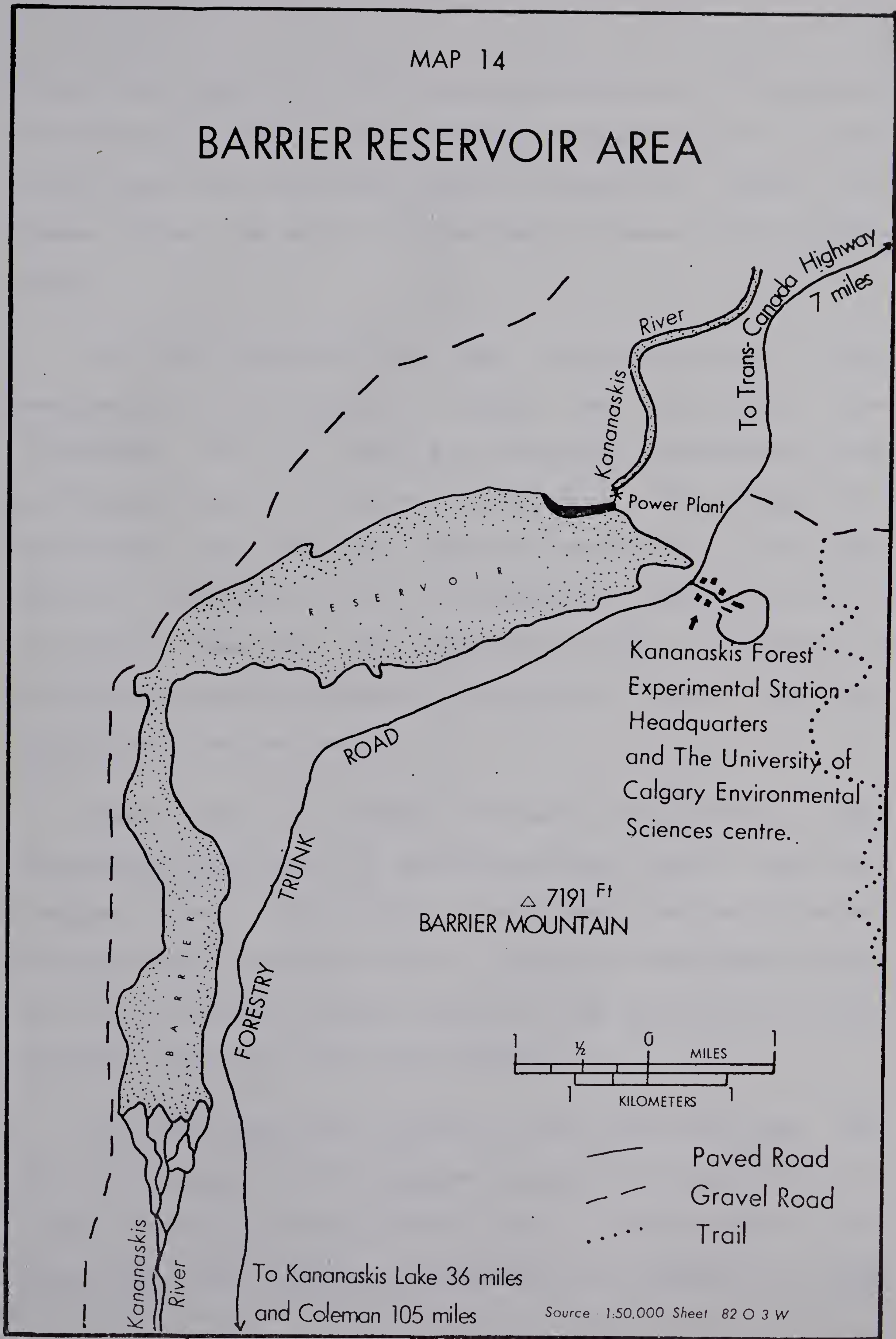
the available facilities can have a significant effect on the numbers, location and impact of recreationists. The facilities of an area will attract recreationists but where facilities are lacking recreation may be discouraged or other sub-optimal areas could be used to the detriment of the recreation area and to the detriment of the public at large because of the less than optimal use of the resources. In Maps 12 to 19, the location of present recreation facilities at the hydro-electric power reservoirs of Alberta is indicated. Also indicated are areas where unofficial recreation sites are found as a result of an excess of demand for recreation facilities over their supply. It is noted that there are very few facilities at the reservoirs outside of Banff National Park, when compared with the recreation facilities at Lake Minnewanka.

At Bearspaw and Barrier Reservoirs there exist no official recreation facilities. Boating takes place from unofficial launch sites and it is known that the upland around Barrier Reservoir supports hikers (Map 14). At Bearspaw Reservoir (Map 12), use limitation is being effected by the subdivision of adjoining lands for suburban residential development.

At Ghost Reservoir (Map 13) there exists one area (15 acres) of cottage subdivision (70 cottages) with boat launch


MAP 12
BEARSPAW RESERVOIR AREA
½
0
MILES
1
1
1 KILOMETERS
Paved Road
Gravel Road
Area of Present subdivision
Unofficial boat launch
Railway
Source : Field Data
Bow River
C.P. Railway
To Cochrane
8 miles
To Calgary
7 miles
Bearspaw Reservoir
Gravel Pit
Power Plant
To Trans-Canada Highway 1 mile
Bow River


MAP 13
GHOST RESERVOIR RECREATION FACILITIES
Paved Road
Gravel Road
Administrative boundaries
Ghost River
To Cochrane
8 miles
Bow River
Power Plant
Stoney Indian Reserve
Morleyville Settlement
Morleyville Settlement
Stoney Indian Reserve
Morleyville Settlement
Ghost Village
70 Cottages
Boat Dock
Reservoir
Ghost
Morley Church Historical Site
Gas well
Stoney Indian Reserve
STONEY INDIAN RESERVE
C.P. Railway
To Exshaw 4 miles
Bow River
Morley
To Trans-Canada Highway 1 mile
Gas well
½
0
MILES
1
1
1 KILOMETERS
Source Field Data

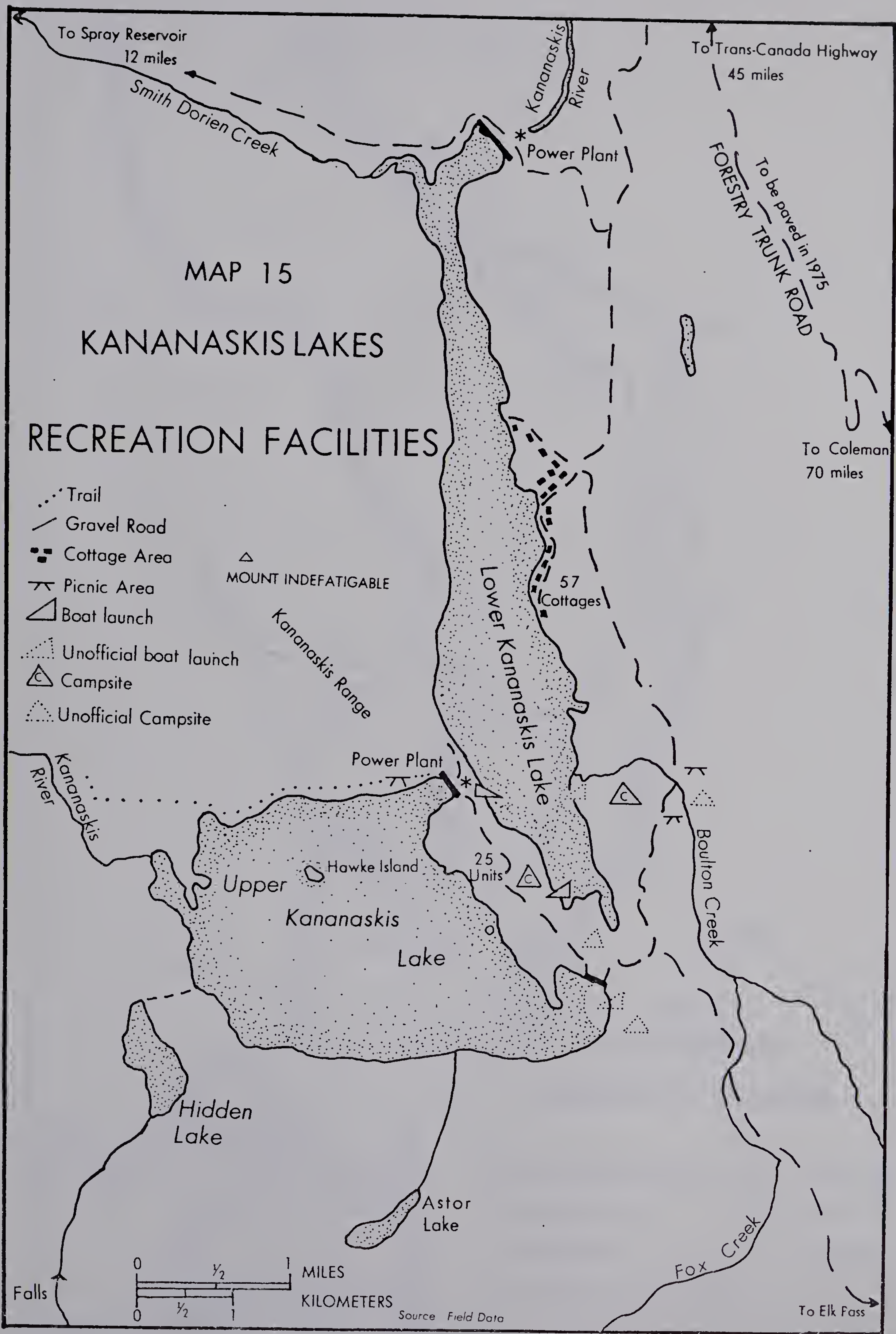

MAP 14
BARRIER RESERVOIR AREA
Kananaskis River
To Trans-Canada Highway 7 miles
Power Plant
RESERVOIR
Kananaskis Forest Experimental Station Headquarters and The University of Calgary Environmental Sciences centre.
ROAD
TRUNK
FORESTRY
BARRIER
△ 7191 Ft
BARRIER MOUNTAIN
1 ½ 0 1
MILES
1 1
KILOMETERS
Paved Road
Gravel Road
Trail
Kananaskis River
To Kananaskis Lake 36 miles and Coleman 105 miles
Source 1:50,000 Sheet 82 O 3 W

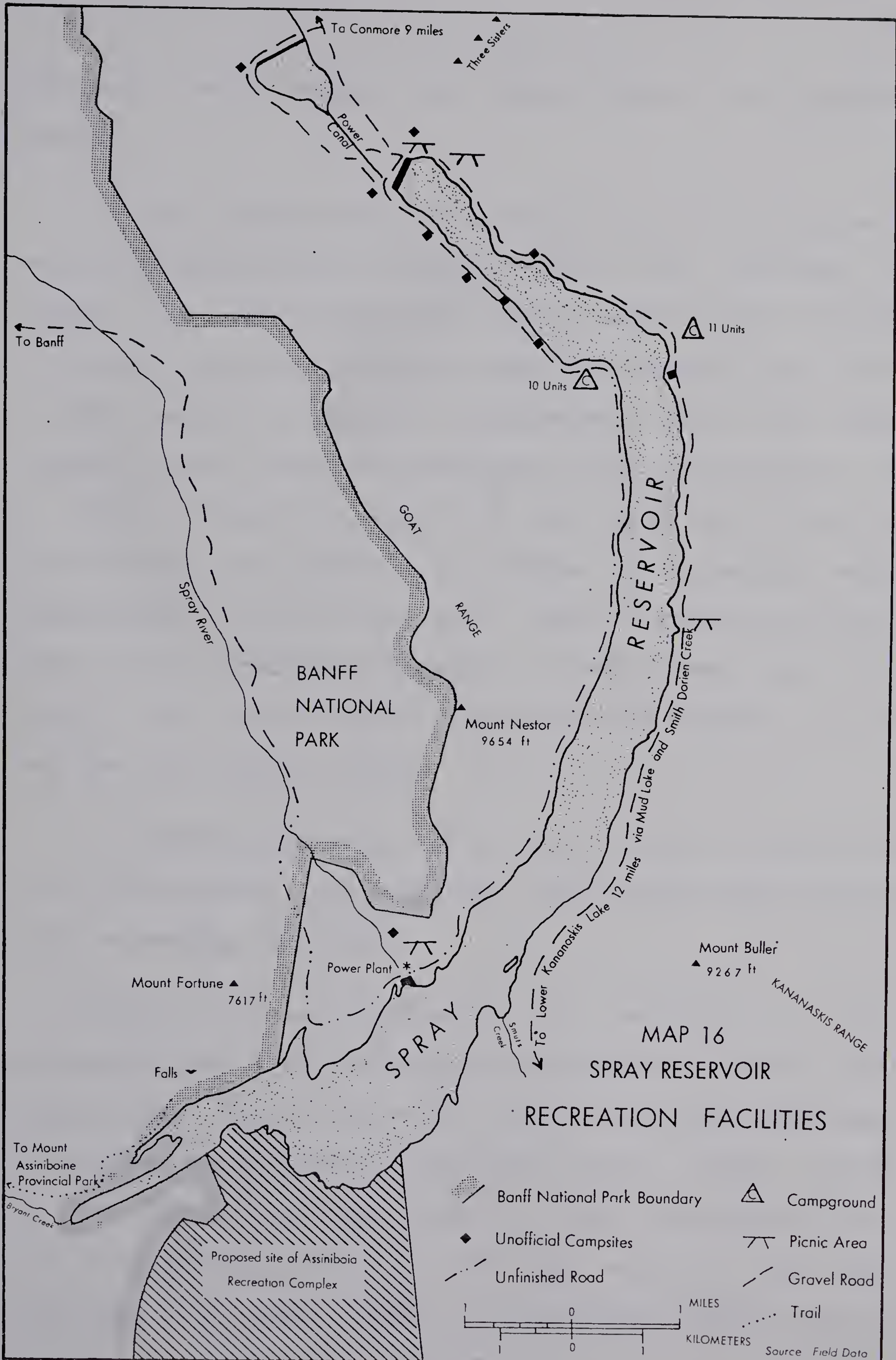
facilities (Plate 18). This area is exclusive to the cottage recreationist (Plate 19). Other non-designated boat launch areas have been used where physical capability permits but these sites are poor in comparison to those at the cottage area.

At Lower Kananaskis Lake (Map 15) there are one cottage subdivision (57 cottages, 70 lots), two camp areas (one structured with 25 units and the other unstructured), one boat launch area and various picnic areas. The demand for recreation in this area, noted in chapter one, is so great that all the sites are used to capacity at peak periods. As a result, much of the recreation area is subject to destruction and despoilment, particularly where unofficial campsites have been made.

There are no official recreation facilities at Upper Kananaskis Lake (Map 15). Unofficial boat launch sites and camping areas exist on the eastern shore but the sites are crowded and as a result are in a state of despoilment (Plate 20). This situation should change on the installation of the proposed Provincial Park (see chapter 7).

The same situation exists at Spray Reservoir (Map 16). The two Alberta Forest Service campgrounds (one site of ten units on the west shore and one site of eleven units on the east shore) are overused, particularly on weekends. No other


MAP 15
KANANASKIS LAKES
RECREATION FACILITIES
Trail
Gravel Road
Cottage Area
Picnic Area
Boat launch
Unofficial boat launch
Campsite
Unofficial Campsite
To Spray Reservoir
12 miles
Smith Dorien Creek
Kananaskis River
Power Plant
To Trans-Canada Highway
45 miles
FORESTRY TRUNK ROAD
To be paved in 1975
To Coleman
70 miles
57
Cottages
MOUNT INDEFATIGABLE
Kananaskis Range
Lower Kananaskis Lake
Power Plant
Kananaskis River
Boulton Creek
25
Units
Hawke Island
Upper
Kananaskis
Lake
Hidden
Lake
Astor
Lake
Fox Creek
Falls
0
½
1
MILES
KILOMETERS
0
½
1
Source Field Data
To Elk Pass



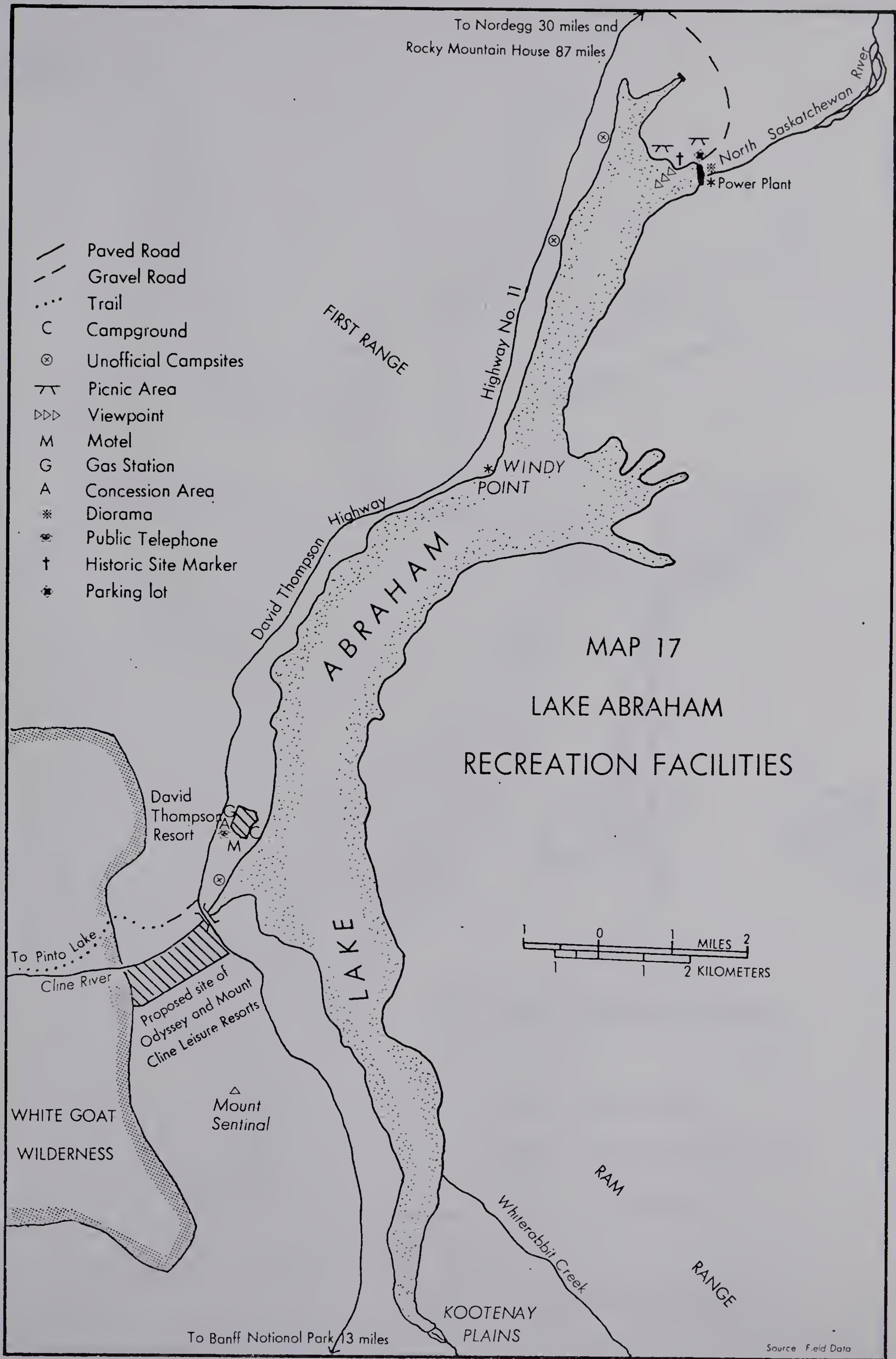
MAP 16
SPRAY RESERVOIR
RECREATION FACILITIES

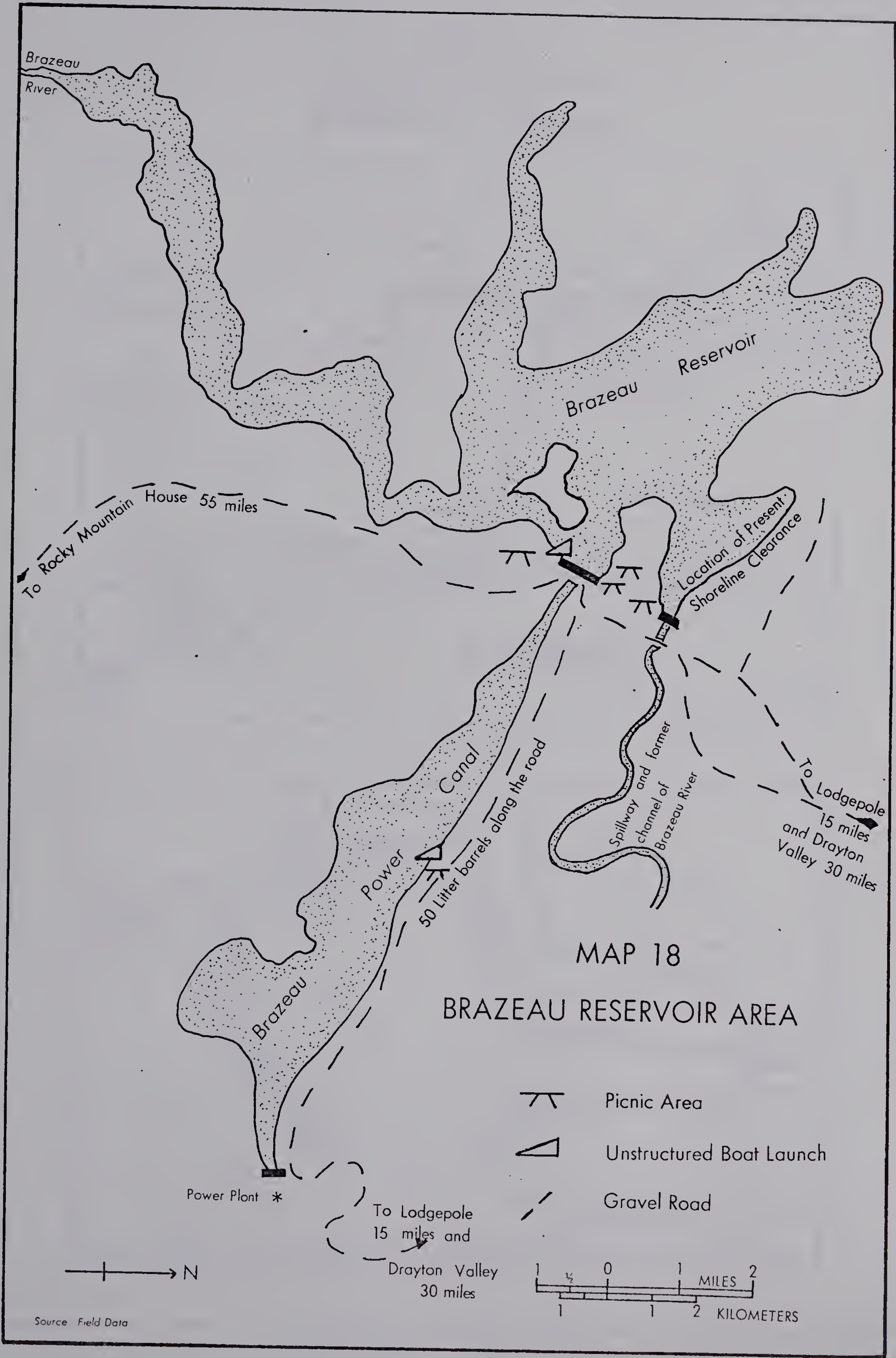
facilities exist except one picnic table at the northern damsite.

At Lake Abraham only one extensive area (12 acres) with recreation facilities is present (Map 17). As indicated in chapter one these facilities are not used to their maximum at present. They are privately owned and operated and cover a wide range of activity preferences (Plate 21). These include camping, motel accommodation, food concessions and an indoor recreation area. At the north end of the lake picnic tables are present. A diorama is presently under construction at the dam site. This is funded by Calgary Power. Other unofficial campsites, picnic areas and boat launch sites are located on the shoreland between the road and the lake (Plates 22-24).

At Brazeau Reservoir (Map 18) five picnic tables and one unstructured, but official, boat launch area are the only recreation facilities.

This is in great contrast to the facilities at Lake Minnewanka (Map 19). The facilities available include a boat launch area in the form of a 100-boat capacity boat dock; boat rental of both cruise and small 12 h.p. boats; trails on both sides of the lake; and a 30 table structured picnic area with parking (Plate 25). To the south of the lake adjoining the power canal, a structured camping site is

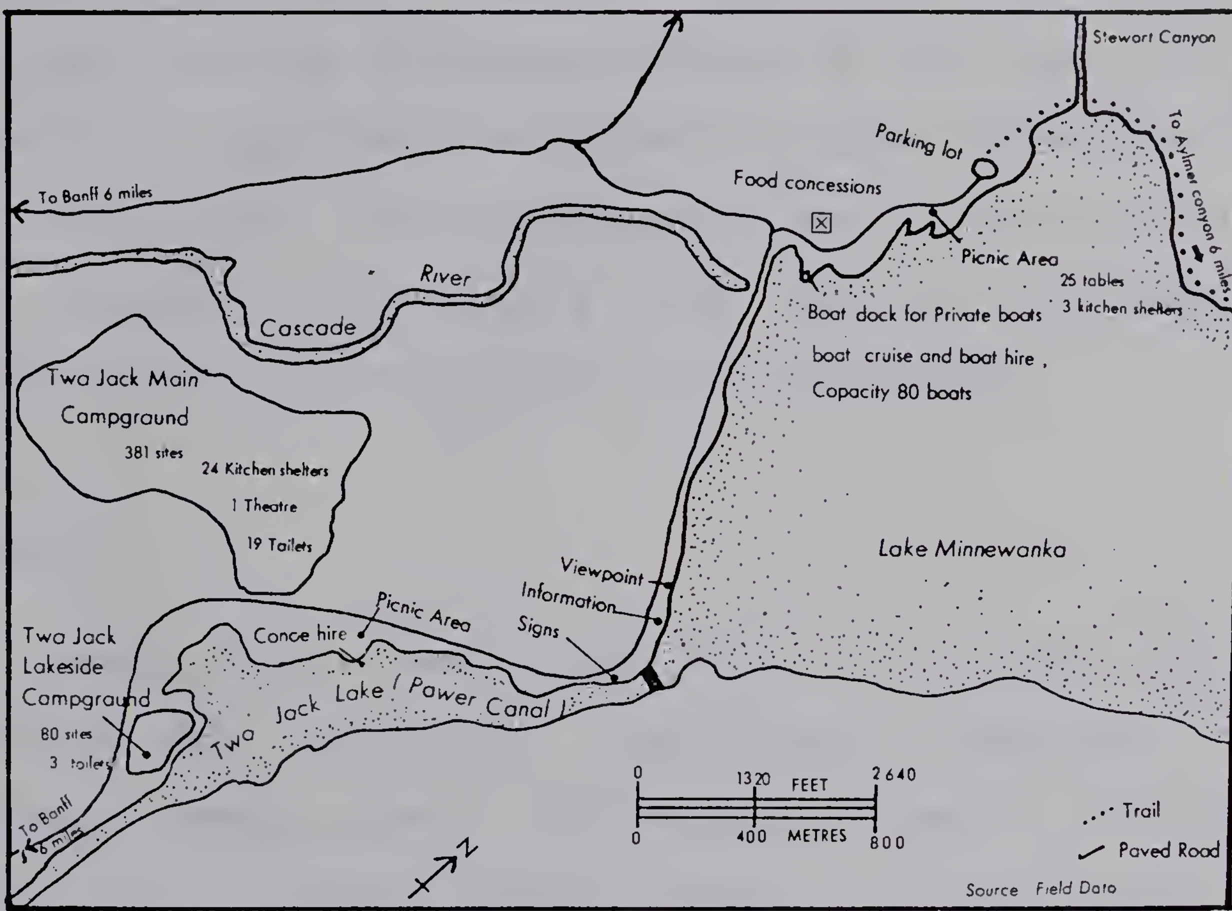

MAP 17
LAKE ABRAHAM
RECREATION FACILITIES
Paved Road
Gravel Road
Trail
C Campground
Unofficial Campsites
Picnic Area
Viewpoint
M Motel
G Gas Station
A Concession Area
Diorama
Public Telephone
Historic Site Marker
Parking lot
To Nordegg 30 miles and
Rocky Mountain House 87 miles
North Saskatchewan River
Power Plant
FIRST RANGE
Highway No. 11
WINDY POINT
David Thompson Highway
ABRAHAM
LAKE
David Thompson Resort
To Pinto Lake
Cline River
Proposed site of Odyssey and Mount Cline Leisure Resorts
Mount Sentinal
WHITE GOAT
WILDERNESS
RAM
RANGE
Whiterabbit Creek
KOOTENAY PLAINS
To Banff Notionol Park 13 miles
MILES
KILOMETERS
Source Field Data

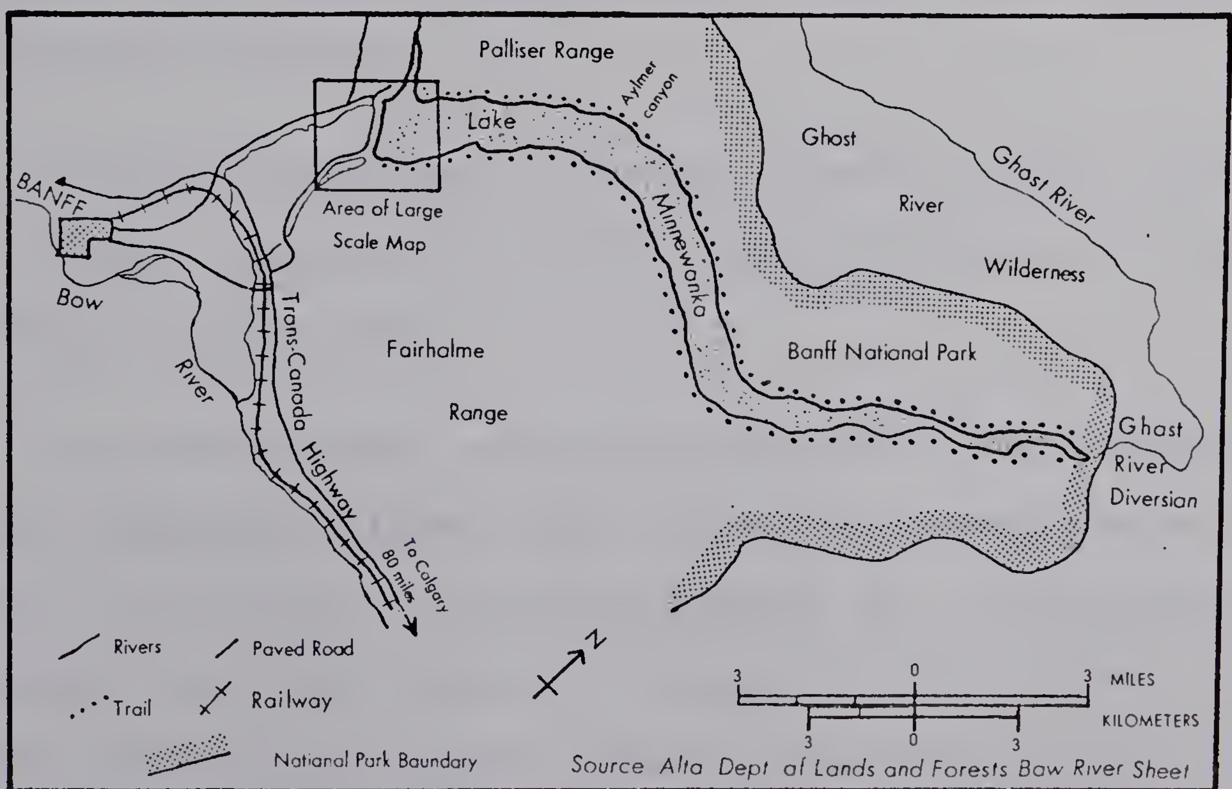


MAP 18

BRAZEAU RESERVOIR AREA

MAP 19
LAKE MINNEWANKA
RECREATION FACILITIES





present with 461 camp units. Within the site flush toilets, camp kitchens and a theatre are provided. On Two Jack Lake non-power boating is possible (Plate 26) and canoe rental is available. Along the access road to Lake Minnewanka there are viewpoints, information signs and picnic tables (Plate 27). Appendix one includes a count of all the facilities present at the hydro-electric power reservoirs.

Access

Access to a recreation area is a very important variable when considering recreational capability. On a regional scale, road availability and quality will affect the numbers of recreationists while on a local scale, the presence of access areas will govern the location of recreation activity.

At Brazeau Reservoir regional access is only possible by gravel roads as the nearest paved highway is at Drayton Valley, 30 miles away.

At Lake Abraham, access is possible by the newly-paved David Thompson Highway (No. 11) which follows the northern shore. It is still a gravelled highway for 24 miles east of Nordegg but this section should be paved by the fall of 1975. This feature should encourage recreational use.

At Bearspaw Reservoir, Highway No. 1a is one mile to the north and Highway No. 1 two miles to the south. Further access is only possible by gravel road but the present subdivision should make paving of the road necessary in the future.

At Ghost Reservoir Highway No. 1a follows the north shore, but access points from the road to the reservoir are limited.

Barrier Reservoir and the Kananaskis Lakes lie close to the Forestry Trunk Road. Originally this was a gravel road but the 50 miles between the Trans-Canada Highway and the Kananaskis Lakes is now being paved. It should be completed by 1976. Already the new road is generating traffic and use should increase in the future (Plate 28).

Spray Reservoir is the most difficult to reach in terms of regional access. The sixteen miles of gravel road include a one mile long hill of average gradient 1 in 7. Furthermore the road is narrow and frequently used for heavy lumber traffic. This has not stopped recreation traffic and recreational use of the road is relatively high.

Lake Minnewanka is easily reached by a paved road from Highway No. 1.

In Maps 12-19 the location and condition of access roads to

the hydro-electric power reservoirs of Alberta is indicated.

Local access is a more complex issue and essentially dependent on land and water ownership. Ghost and Bearspaw Reservoirs are owned by Calgary Power and the land around is privately owned. At Ghost Reservoir access is prohibited to the developed cottage area by the Ghost Village Association. Of the remaining land, approximately 60% is owned by the Stoney Indian tribe and the other 40% by other private landowners. Access over this land is also prohibited and thus the reservoir shoreland is under-utilised for recreation. At Bearspaw Reservoir all land is privately owned. Even the impending suburban development may become exclusive. On the north shore of Bearspaw Reservoir, the main line of the Canadian Pacific trans-continental railroad inhibits access. Where Calgary Power Co. owns land adjoining Ghost or Bearspaw Reservoir they profess impartiality toward recreational use. However there is no formal declaration of their position at the reservoirs, in regard to recreational use. They do prohibit access to areas of public danger or where power installations are threatened by vandalism.

Lake Abraham, Upper and Lower Kananaskis Lakes, Spray Reservoir and part of Barrier Reservoir are in the Forest Reserve. This reserve is crown land and access to all parts of the reservoir is theoretically possible. The only

exceptions are where Calgary Power have dangerous installations, where cottages are on leased ground and where physical characteristics halt access. Barrier Reservoir is a special case as a federal government scientific research station is located on land to the north-east, and an area is set aside for research purposes.

Brazeau Reservoir is also on crown land and access to the reservoir is theoretically possible everywhere. Here and in the Forest Reserve the provincial government has done little to promote or provide for recreational use of the reservoir and associated lands. Limited local access is found at all the reservoirs in the eastern slopes of Alberta. Roads and power lines built by Calgary Power often aid access to the reservoirs and surrounding lands but these installations were not built to accommodate recreation demand.

As Lake Minnewanka is in Banff National Park there is unlimited access to the water area and associated land but future recreational pressures may necessitate development of zones of limited access if conservation is stressed.

<u>Legal Aspects, Public Safety and Legal Liability Issues Involved in Providing Recreational Opportunities at Alberta Hydro Electric Power Reservoirs</u>

The legal aspects pertaining to the hydro-electric

power reservoirs could have a significant impact on the provision of recreation opportunities in these areas. The most significant legislation concerned with the problem is The Provincial Water Power Regulations of The Water Resources Act (Order in Council 1726/57) filed on November 6th 1957. This act subsequently appeared as Chapter 388 of the Revised Statutes of Alberta in 1970 with a subsequent amendment in September 1972 (Order in Council 1550/72). The Water Resources Act of 1957 does not make any specific mention of recreation but recreation could be accommodated under several sections. In particular the possibility of providing for recreational use is present by Section 36 (1) in which there is the statements that "No licensee conveys any exclusive right...to the use of such land". In addition there exists a legal clause that requires Calgary Power Ltd. to enhance certain recreation benefits- "A licensee shall at all times maintain the lands...used by him...including the maintaining of all flooded areas in a sanitary condition and including the improvement of the lands occupied from the point of view of landscape architecture..." (Section 40-1) and again "...every licensee shall...dispose of all brush, refuse or unused timber on public lands...and shall keep the lands...at all times clear of combustible material." (Section 40.4).

If these conditions were strictly adhered to,

recreation would be greatly enhanced. Even though there exists no legal necessity for Calgary Power Ltd. to accommodate recreation, a moral obligation exists for in the case of Lake Minnewanka, Spray Reservoir and Upper Kananaskis Lake, lakes were present before the flooding for hydro-electric power purposes. As these original lakes were formerly available for recreation and as they possibly had a high capability for recreation, compensation in the form of reservoir recreation should be provided. Moreover the flooded areas of all reservoirs had original stream courses, now destroyed, which were also potential recreational resources.

The Water Resources Act of 1957 also contained certain safety clauses:

> 'A licensee...shall do all in his power to protect the lands and the interests of the crown therein against injury by any one engaged on or about his works or by any person whomsoever.'
>
> (Section 40.7)

As a result, safety fences are found at all of the reservoirs and areas of dangerous installations are prohibited to the general public. Further liability can be prevented by a sign indicating private land. Safety and liability on the water is a provincial responsibility as all water is provincially owned.

With regard to the adjoining lands, all land is crown

land in the Forest Reserve. Any recreation developments are thus possible. Where the adjoining land is privately owned, as at Bearspaw Reservoir and Ghost Reservoir, the private landholders can virtually prohibit recreational use. Where Calgary Power Ltd. owns land at these reservoirs, the company professes impartiality to recreational use, but this is a response to the desire for a lack of adverse publicity. At Lake Abraham and Ghost Reservoir native land claims exist over much of the land and this has inhibited growth of recreation facilities and opportunities. At Barrier Reservoir the presence of a federal government research station inhibits recreational use of the surrounding upland.

Land Management in the Study Area

Perhaps more than any other variable, land management has influenced recreational development. In the future it, rather than the physical capability, may be the controlling variable. To evaluate its effect, hydro-electric power development will be traced and then observed in the light of land designation and administration.

The first hydro-electric power installation in Alberta was the Horseshoe plant on the Bow River near Seebe. It came into service in 1911, but it had very poor storage and the need for a regular flow was apparent. Thus it was in 1912

that Lake Minnewanka in Banff National Park was developed as a storage reservoir. Later developments at Kananaskis (1913) and Ghost (1929 - power plant and reservoir) also utilised this storage. Further storage for these plants was installed at Upper Kananaskis Lake in 1932. Lake Minnewanka was directly utilised for power in 1942 and Barrier (1947), Spray (1951), Bearspaw (1954) and Pocaterra (1955) were installed in the post World-War Two years. Additions to earlier storage sites were made at certain times, particularly at Ghost, (1955) Upper Kananaskis Lake (1955) and Spray (1960).

In the 1960's the North Saskatchewan River System was utilised for hydro-electric power for the first time. Brazeau Reservoir was filled in 1969 and Lake Abraham behind the Big Horn Dam was filled four years later in 1973. Table 4 is a historical summary of the development of the power sites.

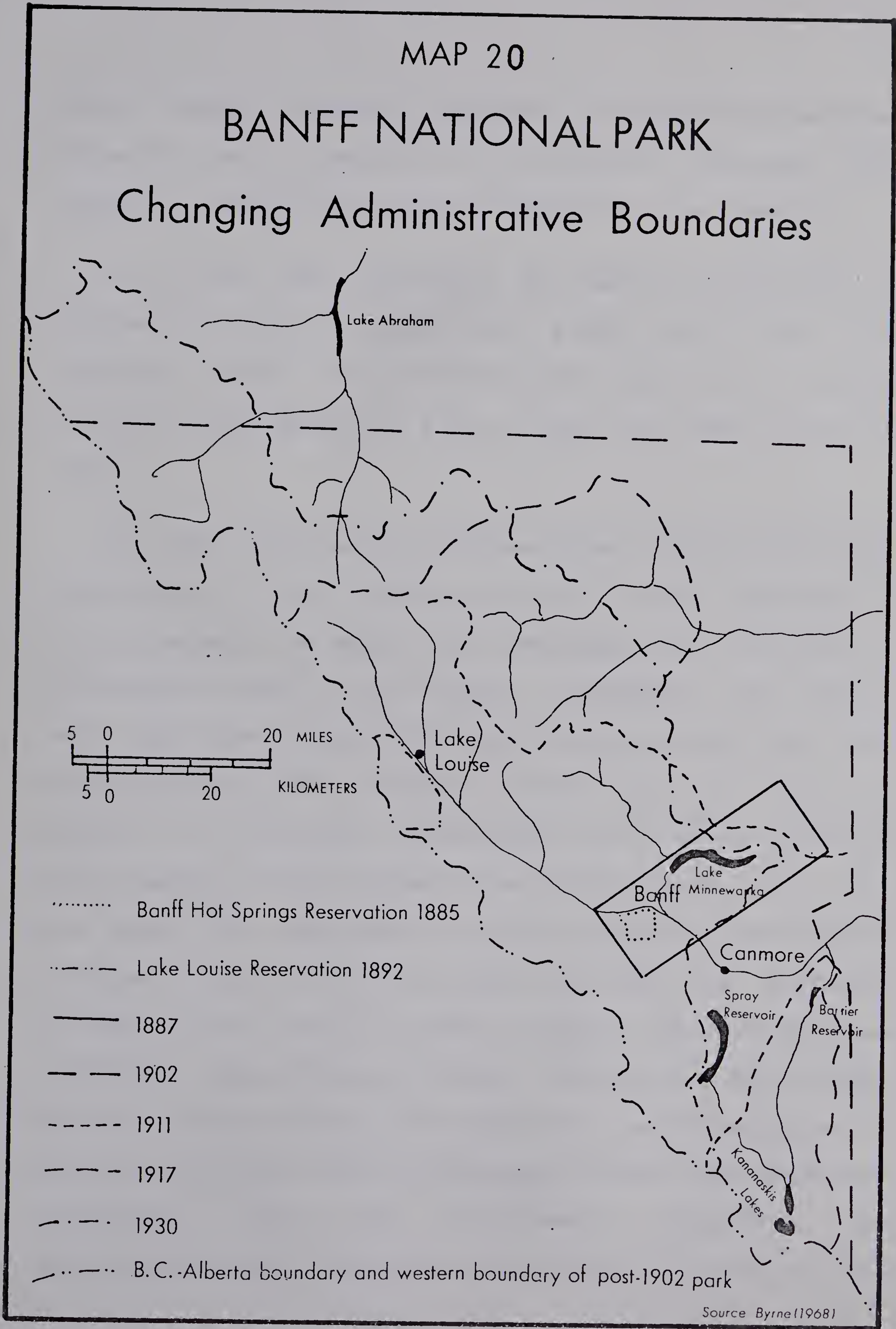
In conjunction with the development of hydro-electric power in Alberta certain changes have occurred in land management and administration of the study area.

The earliest significant impact on the area by white men was the David Thompson expedition of 1786-88 which closely surveyed the North Saskatchewan and Bow Valleys. It was followed by the Palliser Expedition of 1858-60 in which

Captain John Palliser in the course of his travels explored the Bow, North Saskatchewan and Kananaskis Valleys (McGregor 1972, Mitchell 1965).He took inventory of the natural resources and their suitability for agricultural use and in the process he named much of the geological strata, the mountains and the river valleys (Mitchell 1965).

On completion of the Canadian Pacific Railway in 1885, the area was opened up for more intensive use particularly the Banff area, which gained fame for its thermal hot springs. This area was set aside in 1887 as a national park. The area was also recognised as being valuable for its timber , mineral and watershed resources. These were explcited around the turn of the century in a careless and wasteful manner (Byrne 1968). In 1910 the Rocky Mountain Forest Reserve was established by the Dominion Government to protect the timber and watershed resources. This area was distinct from the national park where resource extraction continued. Park boundaries were slightly modified from time to time to expedite resource extraction, particularly in the Bow and Kananaskis Valleys (Map 20).

In 1930 there was a major change in government policy and the administrative framework. National park policy became mcre attuned to conservation and recreaticn and, as a result cf this, Banff National Park was reduced in area. The


MAP 20
BANFF NATIONAL PARK
Changing Administrative Boundaries
Lake Abraham
Lake Louise
5 0 20 MILES
5 0 20 KILOMETERS
Banff
Lake Minnewanka
Canmore
Spray Reservoir
Barrier Reservoir
Kananaskis Lakes
Banff Hot Springs Reservation 1885
Lake Louise Reservation 1892
1887
1902
1911
1917
1930
B.C.-Alberta boundary and western boundary of post-1902 park
Source Byrne (1968)

Forest Reserve became a provincial responsibility although the major aims of forestry and watershed management were retained. Resource extraction continued in the reserve.

In 1942 the exigencies of wartime permitted the construction of a hydro-electric power plant below Lake Minnewanka within the national park. This led to a raising of the 1912 dam from 4775 feet to 4840 feet above mean sea level.

IN 1947 the Eastern Rockies Forest Conservation Board was created. It was a regional advisory body appointed by the government to guide land development and management in the eastern slopes of the Rockies. Watershed and forestry were again the dominant land use concerns in the area. More particularly in 1964 the board stated that it would not promote or encourage recreational use of the conservation area (Eastern Rockies Forest Conservation Board 1964). Such use would be restricted in large sections of the reserve. This was in spite of the fact that the board had previously declared that the area would be managed under multiple use principles (Eastern Rockies Forest Conservation Board 1963). During its term of office the board saw the installation of many hydro-electric power developments which were considered compatible with its management objectives. The administration and operation of the board's program has been

the responsibility of the Alberta Forest Service; hence the involvement of the forest service in providing some of the recreation facilities at the reservoirs.

Since 1956 the area around Kananaskis Lakes that is outside the national park was no longer considered a game preserve and hunting has since been possible.

In 1971 steps were taken to find a replacement for the Eastern Rockies Forest Conservation Board which was to disband on March 31, 1972. A four-stage planning process was started by the Department of Lands and Forests. "The Foothills Resource Allocation Study" was the first stage. In this study resource inventory and capability studies were undertaken, and the preferred use was indicated for the management regions by the use of one single term, "prime use", and without reference to possible multiple use. This was followed by regional economic analysis and social cost-benefit studies. The final stage was the compilation of the studies into a management plan. Only stage one was pursued to any extent while the other studies were relegated in preference to public hearings. Many government agencies became involved and up to the time of writing the fourth stage of the planning process was being studied by government agencies. More public hearings are scheduled for 1975 to discuss this final plan when published. Nothing has

replaced the old regional body or its plans. While these studies are in progress planning has been left to specific government agencies which have interest only in their own field. This has lead to fragmented, uncoordinated resource use, exploitation of the area by the government agencies, and empire building by the various agencies involved.

In the national parks where planning is actively occurring, management emphasis seems to have shifted in the last few years. In the latter 1960's conservation of land, water and wildlife was seen as the major objective. Recently there may be detected a movement towards a policy that is a response to the growing recreational demands placed upon the mountain national parks. Large scale developments of such areas as Lake Minnewanka can be envisioned and these will have an impact not only on the undeveloped parts of the parks but also on the position of reservoirs outside Banff National Park.

Land Use in the Study Area

There is one other variable that will affect recreation development in the study area. That is the position of recreation in regard to other resource uses. The major uses of land and water in the study area may be listed as:

Hydro-electric power
Recreation

Irrigation
Urban and Industrial water supply including storage and pollution dilution
Wildlife consisting of fish, animal, bird populations
Forestry
Agriculture
Mining (coal, oil, gas, gravel, limestone)
Scientific Research
Transportation
Watershed

Each of these uses places demands on the land and water resources. The nature of some of these resources has been evaluated in earlier chapters. However it is worth noting other salient points and re-emphasizing others which have a bearing on the future development of the study area.

Hydro-Electric Power: The development of hydro-electric power in Alberta has been outlined above. Two other factors seem important when considering the present and future role of hydro-electric power production as a resource user. Firstly the high cost of power storage and installation is important and secondly the position of hydro-electric power with regard to present and future sources of energy, namely coal and nuclear fuels, will affect the use of hydro electric production as a source of power.

In Table 6 the rising cost of hydro-electric installation is indicated. At present the costs for additional reservoir development seem too high for any future installation. The power produced has to be great enough to justify the high

TABLE 6. POWER SUPPLY AND COST OF HYDRO

ELECTRIC POWER PLANTS IN ALBERTA.

Alberta Power Ltd.		CAPACITY. MW.		COST Dollars x 1000
All Thermal Plants		524		
City of Edmonton. (Edmonton Power.)				
All Thermal Plants		570		
City of Lethbridge.				
All Thermal Plants		33		
City of Medicine Hat.				
All Thermal Plants.		38		
Calgary Power Ltd.				
Bow River Plants		HYDRO.	325	
Cascade	35.9			4,846
Three Sisters	3.0			1,072
Spray	102.8			15,924
Rundle	49.9			4,423
Interlakes	5.0			1,274
Pocaterra	14.9			2,823
Barrier	12.9			2,237
Kananaskis	18.9			3,290
Horseshoe	13.9			1,974
Ghost	50.9			6,930
Bearspaw	16.9			4,404
Brazeau		HYDRO	355	47,122*
Bighorn		HYDRO	120	45,275*
Wabamun		Thermal	594	
Sundance		Thermal	300	
TOTAL		2,859		

For Lake Abraham: cost of clearing $1,2000,000
Paid for by Provincial Govt.
cost of road relocation $1,5000,000
Paid for by Provincial Govt.
water rental $ 100,000 per year.

Source: T.D. Stanley, Calgary Power Ltd. 1975.

capital expenditure and this is only possible at certain sites where there is the combination of load potential and storage area. Such potential exists on the Peace River at Dunvegan and Slave River below Fort Chipewyan and the Athabasca River above Fort McMurray (McGregor 1958) but no projects are planned for these sites in the immediate future. These sites are compared with thermal plants which can produce greater power at a lower installation cost. Current interest rates for thermal and hydro-electric power installations vary but the bank prime lending rate would be a good approximation of the rates involved.

Table 6 also indicates the role hydro-electricity plays in supplying the electricity grid. It shows a low proportion of power generated by hydro sources. However, hydro-electric power is vital to the provincial electricity grid as it has the capacity to satisfy peaking power demands, which thermal base load plants are less able to do. In regard to future supply of energy, nuclear power or further hydro-electric development can be viable only when the economic conditions of high cost fossil fuel and the lowering of interest rates for hydro-electricity permits their installation. Until then thermal power will be the major source of energy supply.

Recreation It is important to emphasize the need for complementary development of recreation land to meet the diverse needs within recreation. In particular, most of the

hydro-electric power reservoirs of Alberta are in a region adjoining a national park, therefore recreation policies at the reservoirs should not duplicate but complement parks policies. For example, should the national parks become more wildlife and wilderness oriented other needs could be served by those areas outside the national parks. In this connection it is worth stressing again that access and proximity to urban areas are singular features of the recreation demand at the hydro-electric power reservoirs of Alberta. In addition the paucity of water-based recreation opportunities in the Calgary region makes these needs more pressing. It is reasonable therefore to expect that the hydro-electric power reservoirs will fulfill the needs of urban-based recreationists, while more distant regions will meet other recreation needs.

Irrigation The demands on water for irrigation purposes have been outlined in Chapter Three. Future irrigation developments are more vague. Various possibilities for the future have been suggested, many of which involve further storage and inter-basin transfer. In the immediate future, supplementary irrigation is the most likely development. This should not drastically affect the amount and timing of water drawdown in the hydro-electric power reservoirs. A renovation project is also in prospect but this will not involve much expansion and it could result in more efficient

use of available supplies and reduced withdrawal in the short term.

Urban and Industrial Water Use Water from the eastern slopes of Alberta supplies all of the major cities and towns of Alberta and Saskatchewan with domestic water supplies. Furthermore the major manufacturing industries of these provinces are in or near these cities and they draw their water from the same source. At present supply meets demand but this may not be the case in the future, especially in Southern Alberta.

Watershed Management In the discussion above, future water demands were seen as critical. As a result there will be a need for more efficient use of the available supplies. This will involve watershed management and artificial storage related to such needs as regime improvement, flood limitation, quality control and erosion limitation. Each of these management needs require regional application and emphasis. Objectives in watershed management thus need to be defined regionally and locally. In the longer term, there may also be the need for yield improvement for such uses as those suggested above. Furthermore diversion from north-flowing rivers involving storage and multi-use development is in prospect near the regions which now have hydro-electric power development (Saskatchewan-Nelson Study 1972).

Wildlife In evaluating the role of wildlife in this area the

major problem is the value society attaches to this resource. Various attempts have been made to define values for wildlife but the results are highly subjective. There will be no attempt to attach values in this thesis, but it may be pointed out that wildlife may be more plentiful in other areas. In the study area wildlife may not need exclusive protection, only positive management. Furthermore the adjoining national parks have afforded a high degree of wildlife protection in the past and presumably will do so in the future.

Forestry The eastern slopes of Alberta have a long history of timber extraction. The settlement of Western Canada after 1885 brought the need for large timber supplies and extraction has been a major feature in the eastern slopes since that time, especially in the Bow River basin. The last mill in the Kananaskis Valley ceased production in 1944 but quotas for cutting timber still exist for an area south-east of Spray Reservoir and large areas to the east of Lake Abraham. Active cutting is only occurring in the former (Plate 29). The present day disposition of timber rights is by quotas and annual cuts so as to maintain a "sustained yield" of the resource. Clear cutting is the usual pattern of cutting. Apart from these areas under lease, other forested areas are managed for watershed maintenance and hence are unavailable for cutting. Virtually all of the

timber of commercial value is under lease, and hence any major expansion of forestry is unlikely.

Agriculture Most of the land adjoining the reservoirs is unsuitable for agricultural production. Some grazing occurs around Lake Abraham but it is limited in animal number and extent. At Ghost and Bearspaw Reservoirs agriculture occurs on the adjoining land but conflict between the farmers and recreationists is minimal.

Mining Mining could play a large part in the future of the area. Large coal reserves have been identified along the northwest shore of Lake Abraham and reserves are also extensive in the Kananaskis Valley and the area to the east of the two Kananaskis Lakes. A quarry lease for limestone exists along Smith-Dorien Creek and gravel extraction is occurring along the north shore of Bearspaw Reservoir.

Around Ghost Reservoir, large gas fields have been leased (the Jumping Pound Field) and oil and gas leases have been issued for the area around Barrier Reservoir.

The future of mining is uncertain. Canmore has been the centre of mining acitivity ever since coal was discovered and little mining has occurred elsewhere. Nordegg was a centre for coal mining in the inter-war years. However, should markets expand or fuel demand for coal-fired thermal power plants outstrip the capacity of present supply areas

to meet demand, coal mining could be renewed in those areas under lease. Active exploration is occurring in the eastern slopes of Alberta to verify the extent of coal reserves. In all likelihood, strip mining would be used to extract the coal and this would create conflict with other resource users.

For oil and gas the future does not seem to hold much change, and at present conflict with other resource users is relatively low.

Sand and gravel extraction should also continue unhindered at Bearspaw Reservoir.

Scientific Research Since 1934, 494 acres of land have been reserved east and west of Barrier Reservoir for scientific research in forestry and related fields. This reserve is expected to remain but conflict may increase with greater use of the surrounding area.

Transportation Located centrally within Western Canada, the eastern slopes of Alberta are affected by traffic moving north-south in the lee of the Rockies, and, more importantly, trans-continental, east-west traffic. Highway No. 1 is the most important transportation corridor within the region although the corridor also includes Highway No. 1a and the C.P. Trans-Continental railroad. The David Thompson Highway (No. 11) provides an alternative means of

access into the national parks. Further east-west transportation developments are possible: The extension of Highway No. 11 into British Columbia via the Howse Pass has been suggested but no steps have been taken to realise this possibility. Of greater possibility is the branching west of a road from the newly paved Forestry Trunk Road in the Kananaskis Valley into southern British Columbia and northwest U.S.A. Such a road would take pressure off the excessively used Trans-Canada Highway (No. 1).

Other transportation developments depend largely on other land use developments. Any possible rail re-opening in the Nordegg area would be in response to a renewed development of the coal resource. In the Bow Valley, rail provision is at a maximum at present.

Air transportation developments are more difficult to evaluate. There is potential for small aircraft operations to provide access into remote areas, particularly into the wild land areas in the North Saskatchewan River basin. The large urban centres should accommodate increases in large scale air operations.

Conclusion

This chapter is a summation of the factors that have to be taken into account when suggesting possibilities for

recreational development at the hydro-electric reservoirs of Alberta. It completes the first stage of the planning process as outlined by Mcloughlin (1969 p. 95), namely the collection of a data base. The following chapter contains a discussion of the second and third stages of the planning process; that is a statement of the objectives and the derivation of possible courses of action at the individual reservoir sites.

Chapter 7

ALTERNATIVE DEVELOPMENT STRATEGIES FOR THE STUDY AREA

In the first three chapters of this thesis the problems associated with increasing recreation demand, and the need for recreation land to meet these demands were stated. The recreational resource capability of the hydro-electric power reservoirs was then evaluated in chapters four and five and the influence of management and land use development was traced in chapter six. Using this background material, the final step is to suggest alternative development measures for the reservoirs and to suggest management agencies which could implement the proposals.

The Statement of Objectives

A major goal of society is that, in meeting current and projected needs and resolving problems in recreation, there is an improvement in the quality and quantity of recreation opportunities for the majority of people. The more specific objective in this thesis is one of assessing the potential of the hydro-electric power reservoirs for meeting increasing recreational demand. This is part of a broader problem in which other resource users have needs and problems, therefore planning for recreational use of land

and water resources must accommodate other regional and local demands where possible and in some cases give way to them. This is the basis for a second objective which is for comprehensive multi-use planning with the greatest collective return for the people of Canada.

Complementarity and Conflict in Multi-use Planning

The ideal situation in comprehensive multi-use planning is where the objectives of all resource users are essentially complementary. In this case, only a single plan would be necessary for the area under study. Unfortunately, it is more likely that the resource users will be in conflict - the satisfaction of one use reducing the satisfaction of the others. It is thus necessary to establish which uses are compatible and which are in conflict. Table 7 is a compatibility matrix in which all resource uses in the eastern slopes of Alberta are compared as to their level of compatibility. From this matrix, land and water resources can be allocated so that the resource is used for one, two or more purposes either at different times or simultaneously.

TABLE 7 COMPATIBILITY MATRIX FOR THE LAND USES IN THE STUDY AREA

PRIMARY USE	Hydro.	Recreation	Watershed	Forestry	Irrigation	Agriculture	Water Supply	Mining	Wildlife	Wilderness	General Conservation
Hydro-Electricity		Moderate compat. depends on drawdown	Incompat.	Fully Compat.	Moderate compat. depends on time of withdrawal	Moderate compat.	Compatible	Usually compat.	Generally compat.	Incompat.	Low compatibility
Provide Recreation Opportunity	Mod. compat.		Mod. compat. depends on locat. and int-ensity of use	Limited compat.	Generally compatible	Low compat.	Compatible	Incomp.	Usually compat.	Incompat. for high intensity use	Mod. compatib.
Watershed Management	In-compat.	Mod. compat.		Can be fully compat.	Can be fully compat.	Moderate compat.	Needs high compat.	Incomp.	Usually compat.	Low compat.	Can be high compatibility
Forestry Production and harvest	Fully compat.	Can be fully compat.	Can be fully compat.		Generally compatible	Low compat.	High compat.	Low compat.	High compat.	Completely incompat.	Moderate compatibility
Irrigation	Mod. compat.	High compat.	Can be highly compat.	Gener-ally compat.		High compat.	High compat.	Low compat.	Mod. compat.	Low compat.	Moderately compatible
Agriculture	Mod. compat.	Low compat.	Mod. compat.	Low compat.	High compat.		Compat.	Low compat.	Low compat.	Incompat.	Low compatibility
Industrial and domestic water supply	Compat.	Compat.	High compat. needed	High compat.	High compat.	Compat.		Incomp.	Generally compat.	Incomp.	Generally compatible
Mining	Usually compat.	Incompat.	Low compat.	Low compat.	Incompat.	Incompat.	Incompat.		Incompat.	Completely incompat.	Incompatible
Wildlife Management	Gen. compat.	Usually compat.	Usually compat.	Generally compat.	Generally compat.	Low compat.	Compat.	incomp.		Low compat.	Compatible
Wilderness	Incomp.	Low compat.	Low compat.	Incompat.	Low compat.	Incompat.	Low compat.	Comp-letely incomp.	Mod. compat.		Moderate compatibility
General conservation	Low compat.	Compat.	Can be high compat.	Mod. compat.	Compat.	Mod. compat.	Compat.	Gen. incomp.	Highly compat.	Highly compat.	
Scientific Research	Compat.	Incompat.	Low compat.	Compat.	Compat.	Low compat.	Low compat.	Incomp.	Low compat.	Incompat.	Generally compatible

It is to be noted that the matrix is highly subjective yet it helps users to focus upon a range of alternatives and it gives a wider perspective on the problems to be faced in land management.

Zoning

In order to allocate land and water resources to various needs, it is necessary that zoning of uses be undertaken. With the use of zoning, competitive land uses can be separated or reduced in degree, while still permitting the conjunctive use of other compatible resources. It is desirable that the zones are kept as flexible as possible, for demands for resource use may change through time.

Use Priorities for Resources in the Eastern Slopes of Alberta

In multi-use resource development some uses must have priority owing to their national, regional and local importance. Where the resource uses are generally compatible, priorities need not be fixed, but where uses are in direct competition one use must be given priority. Table 7 is a listing and initial assessement of the major land use categories that are in need of scaling. These are watershed, mining, recreation, scientific research, agriculture and

wilderness which stresses wildlife conservation. One classification widely used to scale priorities has four categories (Wilm and Dunford 1941). These are exclusive, dominant, co-dominant and subordinate. Each of these major land uses will be scaled using this classification.

Watershed: Future considerations for water supply necessitates that watershed should be a dominant land use in the eastern slopes. It need not be considered exclusive if management objectives are set for its use. To illustrate, if the management objective was for high yield this could be combined with forestry harvest. If the objective was for a better regime then conservation of resources by forest protection and encouragement should be stressed. However integrated resource use with watershed dominant is only possible if management objectives are established for the whole of the region.

Mining: In contrast, mining should be considered exclusive. This is because the high demands for raw materials require that extractive industries become a part of resource use in the eastern slopes. Furthermore the physical and aesthetically displeasing nature of the exploration and extraction process precludes all other uses until reclamation is complete. It should be noted that mining may be considered exclusive only if there are no alternative areas. In the eastern slopes of Alberta this is rarely the

case. As a result other land uses may have priority in some areas. Furthermore site rehabilitation for future use is an important aspect of mining location. In general mining activity should be acceptable as it is a necessary use and has a high productivity in very localised areas.

Scientific Research: This use is also exclusive in the designated areas. This too can be tolerated over a small area and where the research is ongoing. Elsewhere, pure research projects are possible and can be permitted but they should be subordinate to other uses.

Agriculture: In the eastern slopes of Alberta, the only agricultural activity in conflict with other land uses is grazing. This conflicts with watershed, recreation, and wildlife. As these other uses must have priority, grazing should be co-dominant in localised areas where it is complementary with other uses and with ranching to the east and elsewhere made subordinate.

Recreation: The nature and objectives of this thesis are to study the opportunities involved in meeting growing recreational demand by the utilisation of the hydro-electric power reservoirs of Alberta.

However the diverse nature of the activities within recreation makes the assignment of use priorities difficult. In places, recreation may be exclusive (ie. a picnic area or a parking lot) whereas in other areas recreation could be

subordinate (eg. to hydro-electric power production). It is necessary that subdivision of recreation activities and areas be undertaken to identify the acceptability of development proposals. Such a subdivision is made in the C.L.I. for Recreation and this can be used in conjunction with the classification of reservoirs and associated lands outlined below.

Wilderness: Land designation for wilderness has been suggested for much of the eastern slopes of Alberta. As one objective of the writer is to recommend the optimum use of resources by multi-use planning means, the competitive and almost exclusive nature of wilderness areas lessens the chances of it being recommended for large areas of the eastern slopes. Furthermore as wilderness areas already exist over large parts of the eastern slopes, the provision of more exclusively wilderness areas should rate low on a list of priorities.

In addition, wildlife enhancement and conservation are often suggested as additional advantages of wilderness designation. This is not strictly true, as greater enhancement and conservation of wildlife could be provided by positive management (such as feed supplementation and burning to encourage browse) which wilderness would militate against. Such management would be more oriented to the needs of the hunter whereas wilderness creation discriminates

against such recreation activities.

A Classification of the Components Involved in Accommodating Recreation at Hydro-Electric Power Reservoirs

As was seen in chapter five, much of the planning in the study area has become fragmented and uncoordinated, owing to the lack of an integrated management plan. This has lead to single use and single means planning (White 1971). To plan on a multiple use basis, a study of development alternatives is advisable, and to aid in this study, classification is a useful tool. Classification permits a greater stress on the availability of alternatives. It enables the alternatives within a multi-use planning framework to be structured by acting as a model and it helps in setting a pattern for other subsequent studies elsewhere.

The classification is specifically for the study of recreational use of reservoirs but it could be modified for other resource uses. It is based mainly on other studies outlined in chapter two but it also utilises data and classifications developed in other chapters.

A Classification of Recreation Components at Hydro-Electric Power Reservoirs

A. RESERVOIR AND SHORELAND

a) Size and Measure

(i) surface area
- 0-200 acres
- 200-500 acres
- 500-1000 acres
- 1000+ acres

(ii) shoreline length (in miles) and reservoir shape
- linear
- arcuate
- sinuous
- bulbous

(iii) depth in feet

(iv) water quality and temperature (summer/winter)

(v) climate

(vi) shoreland composition and gradient
- glacial
- bedrock

(vii) beach length and area in miles and acres

b) Recreational capability — C.L.I. classification

c) Developments

(i) Local access — roads, trails, easements

(ii) drawdown — 0-10', 10-50', >50'

(iii) clearance

(iv) shoreland management — recreation facilities

(v) other

d) Management for environmental enhancement or preservation

(i) physical	bioenvironmental zoning
(ii) legal	institutional measures pollution standards
(iii) special	interbasin transfer further upstream storage

B. ASSOCIATED LAND AREA

a) Physical characteristics

(i) physiographic province	mountains foothills plains shield
(ii) biological diversity	vegetation life zone wildlife soil

b) Location

(i) urban proximity

(ii) day-use zone

(iii) tourist region

c) Recreational capability of upland

d) Land use (including reference to compatability matrix and use priorities)

e) Developments

(i) accessibility	public roads paved single highway divided highway gravel unimproved

	trails railways air transport
(ii) public amenities	resorts youth hostels
(iii) other	

f) Management for environmental enhancement or preservation

(i) physical	fire bioenvironmental watershed management
(ii) legal	dedication institutional zoning
(iii) special	

Alternatives for Recreational Development at the Hydro-Electric Reservoirs of Alberta

Having established a data base, and defined the objectives behind the thesis it is now possible, using the classification, to develop alternative courses of action for recreation at the hydro-electric power reservoirs of Alberta. Each reservoir will be discussed separately except that Spray Reservoir, Barrier Reservoir and Upper and Lower Kananaskis Lakes which will be regarded as being within one regional unit. Development alternatives will be discussed, firstly for the reservoir and associated shoreland area, and secondly for the associated land area. The alternative courses of action are heavily dependent on the recreational

capability according to the C.L.I. for Recreation and on the multi-use principles outlined earlier.

Lake Minnewanka

At Lake Minnewanka there is no size limitation on recreation activity. Low water temperature limits swimming and water skiing as at all mountain reservoirs. There is also no beach area. From the recreational demand data it can be seen that with the present facilities, this reservoir is at present at a point of optimum use. To accommodate further use, expansion is necessary. Two alternatives are possible. Firstly the expansion of the existing facilities could occur. This would involve an extension onto land to the west of the power canal which is of a lower capability for recreation. This would be on land that is not adjacent to the water. The second alternative is for a road to be built northward from Johnstone Lake alongside the eastern shore of the power canal. This area has a high capability for recreation. Possible activities include lodging of any type, boating and angling. There is the further possibility that the developed area could be extended to the shore of Lake Minnewanka, where an alternative boat launch area could be provided. In conjunction with this development, other improvements are possible. The trail on the south side of Lake Minnewanka could be upgraded to a standard such that a

large number of recreationists could walk to the scenic waterfall. The trail on the north shore is adequate for present use. The local possibilities for a nature walk with labels cn outstanding plants and views should also be investigated. The area around Stewart Canyon presents interesting possibilities in this respect. These developments would effectively zone the west end of the lake and the power canal for intensive recreation activity leaving the east end accessible only to the hiker and cruise boats.

With regard to environmental management there is little to be done. Local zoning results in the prohibition of power boats cn Two Jack Lake and is integrated into the provisional master plan for the park as a whole (National and Histcric Parks Branch Ottawa 1969). Bioenvironmental standards in the fcrm of carrying capacities are being established and are receiving high priority.

With regard to the associated land area, Lake Minnewanka is in a unique position of being within a national park and therefore it should be largely recreation oriented. The only potential land use conflicts are with irrigation and hydro-electricity drawdown. However the high recreational quality of the site and the international, national and local reputation of the area should make

irrigation and hydro-electricity subordinate land uses in the summer months. These demands can be met elsewhere. Watershed management is attuned to regime improvement at the present time. This is acceptable. Possible forestry management by the use of fire should be fully evaluated as to its consequences for watershed.

In regard to regional development, thought should be given to a road from the Forestry Trunk Road into Banff National Park and located along the southern shore of Lake Minnewanka. This would meet demands for day-use recreation. The proposed Cascade road from Lake Minnewanka to the Lake Louise area along the Cascade River should also be reconsidered. Various side roads to viewpoints could also be constructed. In this regard a road onto the spur to the east of the Cascade River should be considered. Such a viewpoint would provide a vista taking in Mount Aylmer, Aylmer Canyon, Mount Inglismaldie and Lake Minnewanka. In addition a mountain viewpoint reached by a road along Carrot Creek would provide a similar view of Mount Aylmer, the Palliser Range and Lake Minnewanka. Smaller developments such as a loop road southwest of Lake Minnewanka would not substantially alleviate recreational demand in the Lake Minnewanka area.

Environmental management in the form of zoning must be

closely related to such future developments. In conjunction with this, quotas on the number of recreationists using the facilities should be imposed if demand is considered excessive.

Brazeau Reservoir

Brazeau Reservoir is the largest hydro-electric power reservoir in Alberta in terms of shoreline miles. This length is over 70 miles and could reduce recreational participation intensities. Gradients into the water are generally low but shoreland composition is lacustrine over much of the area and hence the shoreland is often fragile or marshy.

Recreational capability is low according to the C.L.I. for Recreation and developments are limited. The greatest possibilities for recreational development lie on the power canal even though fluctuation of level occurs. More boat launch areas with better access could be provided. There is also a need for a structured campground. Land capable of supporting a campground is found 50 yards to the north of the embankment on the north side of the power canal. More day-use picnic facilities should also be provided. On the reservoir, fishing should be encouraged by stocking. Recreation in general will be encouraged by the clearance of

the stumps.

In the associated land area the biological diversity should provide hunting opportunity. This should be compatible with other resource users. The major land use conflict at the reservoir lies between hydro-electricity and recreation. Hydro-electricity should be the dominant use as the power plant produces 40 per cent of the provinces hydro-electricity. This would prevent limitation of drawdown.

Management for recreation is not a pressing concern at this time. Zoning of the canal and reservoir may have to be undertaken if recreational pressures become excessive. In the meantime limited development such as better boat launch areas is suggested and the costs of much of this should be borne by Calgary Power.

Lake Abraham

At Lake Abraham the only limitations classified under size and measurement are climate and water temperature. These can be overcome, to some extent, by the use of zoning (see below). As the reservoir is newly constructed there is great scope for developments. Local access roads to the reservoir could be improved and easements into the water provided. This would be greatly aided by the limitation of drawdown. Access points would be best sited at Tershishner

Creek, Allstones Creek and the mouth of the Cline River, where the C.L.I. for Recreation indicates suitable boat launch sites. Picnic facilities or campsites could also be provided at these sites. A trail along the eastern and southern shore of the reservoir would be an asset in meeting the recreation potential of the reservoir.

Environmental management is needed for such developments. Bioenvironmental studies would be necessary to ascertain the carrying capacity of the new development areas. In order to permit boating, strict zoning of areas not subject to high winds must be made. Applied research is necessary here. Consideration must also be given concerning the existing facilities in the areas which are providing similar services to those envisioned but which are commercial operations.

In the surrounding upland the physical characteristics provide the basis for potential conflict. Mining and forestry interests are prominent in the region. Watershed management is necessary and there is potential conflict between hydro-electric power use and recreation. Mining, if localised, is acceptable. Forestry, watershed and recreation are compatible if the management objectives for all three are closely defined and not considered exclusive. Conflict between recreation and hydro-electric use is unavoidable.

However the high recreation potential of the region, the proximity of the reservoir to Banff National Park and the relatively low contribution (15%) of the Big Horn power development towards the provincial hydro-electric power supply suggests a stronger recreational priority for Lake Abraham. Drawdown need only be limited seasonally, not stopped. It would be desirable to limit this drawdown during the summer season in order to enhance recreation. Greater utilisation of thermal power at this time should be considered. If the need for hydro-electric power is felt to be vital to the system the possibility of further storage or interbasin transfer should be investigated.

Regional improvements are possible. The eastern side of the reservoir could be opened up for more intensive recreation by the building of a road. Such a road would have great scenic value. If the impact of a road was seen as being too great, a trail would be acceptable. This trail would link with trails into the Siffleur Wilderness and with the trail system at Ram Falls.

As recreational pressures are increasing, it is necessary that amenities be provided for the recreationist. To avoid national park conjestion, facilities should be located outside park boundaries. The Lake Abraham area is situated such that opportunity exists for the area to

fulfill this function. Such facilities must be concentrated around the existing recreational development to avoid unsightly ribbon development. This centre would provide a base for more intensive use of the surrounding wilderness areas and the Kootenay Plains. In particular, trails to Pinto Lake and Banff and Jasper National Parks could originate here. Under such a development scheme, commercial centres would be acceptable. The public hearings on the eastern slopes of Alberta (Alberta Environment Conservation Authority 1973) included submissions for specific commercial recreation and tourist development proposals. Within these submissions was a request for land to be set aside for a resort village on the Cline River (Map 15). The development was to be called The Odyssey. This proposal was encouraged but has not yet been approved. When viewed in conjunction with the proposals presented above the submission should receive further support.

To permit such developments, detailed management plans have to be formulated. These would involve physical standards to safeguard the environment and legal decisions in respect of native rights, institutional and administrative divisions and zoning boundaries. It is emphasized that these management boundaries should complement national parks aims and policies. In this respect thought should be given to the Lake Abraham area being

included within the national parks. The overriding need is for a management plan before pressures in the area become too great for sound planning.

Bearspaw Reservoir

At Bearspaw Reservoir the only physical limiting factor is the generally steep shoreland gradient. One potential beach area exists on the southern shore and this could be improved by importing beach sand. This would create a demand for more recreation facilities such as picnic areas, concession stands and boat launches. These could be provided as the land has the capability according to the C.L.I. for Recreation. Zoning of the water surface may have to be implemented if the demand for recreation were to become too great. The elongated shape of the reservoir would suggest that sail boating might be excluded in favour of power boats.

As the reservoir is located near to Calgary the greatest pressure from other land uses is from suburban subdivision. This can only be tolerated if access to the reservoir is permitted for other recreationists. Mining is also present at the reservoir but it is localised and not in conflict with recreation. Drawdown for hydro-electric production is less than ten-feet. Such a fluctuation in

level is acceptable to most recreationists including those wishing to launch boats at the reservoir.

Environmental management issues should centre on the need for pollution standards if development becomes more intensive. Pollution can be monitored and hence controlled and should not limit recreational development. Recreational development would be assured by the provision of a provincial park at the reservoir. This would effectively halt exclusive utilisation of this land by a small group of landowners.

Ghost Reservoir

Ghost Reservoir is large enough to permit all kinds of boating activity but swimming opportunities are limited owing to the cold water. Shoreland gradients are fairly steep, enough to limit recreational capability to Class 4 according to the C.L.I. for Recreation. The only Class 3 area is confined to the cottage area. Development of the reservoir for recreation could go further, especially if public access was permitted at Ghost Village where better boat dock facilities could be provided. Otherwise thought should be given to revoking the leases of the cottage owners and making the area a public recreation area. Beach sand could be imported to create a small beach area. Smaller boat

launch areas are needed at present at the confluence of the Ghost River and the reservoir and at points around the dam. In the C.L.I. recreation classification opportunity for these activities at these sites is indicated. Road access to the reservoir is in need of improvment. More picnic sites should be provided along the shoreline and along Highway No. 1a. Those that exist at present need upgrading.

Management of these developments should focus around the need for zoning. If Bearspaw Reservoir was zoned for power boating, Ghost Reservoir should be reserved for sail boats and if the reservoir was judged to be large enough, limited power boating might be accommodated. The shoreland not in the Indian reservation might also be considered for provincial park status, and some Indian land could become the site for cottage development owned by the Indians.

The associated upland area has limited recreational use. On the south side of the reservoir native land ownership limits recreation. On the north side, opportunities exist for more trails into the front ranges of the Rocky Mountains. A road from Morley to Kangienos Lake may alleviate recreation pressure on other areas.

The major problem at Ghost Reservoir is the conflict between land uses. Hydro-electric power production, irrigation and recreation are the major uses of the water.

The hydro-electric plant produces 15 per cent of Calgary Power's Bow System hydro-electric output. This involves a seasonal drawdown of 25 feet. Irrigation demand is met in mid and late May and contributes an additional ten feet of drawdown. Recreation at present is limited to a small number of cottage owners who want no drawdown. Such exclusive use would make recreation subordinate in a priority assessment. If recreation was to become less exclusive, higher priorities might be assigned. Irrigation demands are reasonable. This too should be a dominant land use. Hydro-electric production storage can also accommodate irrigation demands without major conflict between the two uses. Hydro-electric production should therefore be classified as co-dominant and moderately competitive. The degree of trade-off should be closely related to demands for all resources. Naturally to implement such a system strong regional management is necessary.

Barrier Reservoir, Spray Reservoir, Lower and Upper Kananaskis Lake

Barrier and Spray Reservoirs and Upper and Lower Kananaskis Lakes are evaluated together for development at one reservoir should influence and complement development at the other reservoirs in the area. In addition development possibilities for the newly created Kananaskis Provincial

Park will be suggested for preliminary planning at this stage of development is vital for the success of the area as a centre for recreation.

In regard to size and measurement, the sizes of all the reservoirs are such that conflicting recreational developments can be widely separated. Limitations on recreation activities exist at all the reservoirs owing to water temperature and it has been noted that some reservoirs suffer adverse climatic conditions. Despite this, there are development possibilities. At all reservoirs stump clearance would be beneficial to recreational use. Only cost stops clearance at this time. Legal pressure could be brought to bear on Calgary Power to pay for clearance. In addition better access to the water could be made by providing boat launches. This is desirable at all reservoirs. At Lower Kananaskis Lake there is a need for the upgrading of existing boat launch areas. Local access would be aided by road paving.

More facilities are needed to accommodate the excessive demand for recreation noted in chapter five. At Spray Reservoir the most pressing need is for more campsites. Map 8 indicates that there is a high capability for more campsites on both the east and west shores. At Lower Kananaskis Lake the potential exists for an extensive

camping area on the east shore. Although this site does not adjoin the lake, it has the physical and biological capacity to accommodate large numbers of recreationists. The existing campgrounds should be closed temporarily to allow for the recovery of the sites. At Barrier Reservoir recreational capability according to the C.L.I. for Recreation is lower. It is therefore suggested that Barrier Reservoir be developed as a picnic and fishing area. Some small camp areas could be provided on the west shore.

Management of the reservoirs and shoreland should initially be concerned with the carrying capacity of the recreation sites and the reservoir area. Attention should also be focused on the institutional arrangements which permits cottagers to have exclusive use of much of the shoreland at Lower Kananaskis Lake. Consideration should be given to the possibility of modifying or even revoking the leases. Zoning of the reservoirs, with only sailboats permitted on Lower Kananaskis Lake and power boats on Upper Kananaskis Lake may be necessary in the future.

As the associated land area has great variety, physiographically and biologically, the demands on the resources are high. The uses include mining, watershed, forestry, hydro-electricity and recreation. In the immediate vicinity of the reservoirs mining interests are not high.

Better opportunities for mining are found in the Highwood Valley further south. Watershed management is important for the future but must be integrated with other resource uses. Forest harvesting is present but the operation is small and relies on strip harvesting methods. Lumbering could be related more to watershed needs by selective cutting. Such harvesting methods would not harm regime or quality and future yields would also be protected. Moreover, such cutting would be aesthetically pleasing to the recreationist. As such forestry harvest would be a positive management tool. The hydro-electric power plants dependent on storage at Barrier Reservoir, Spray Reservoir and Upper and Lower Kananaskis Lakes produce twenty-three per cent of the province's hydro-electricity. This contribution is vital for it is used to meet peaked demand for power. The plants at Upper and Lower Kananaskis Lakes produce only 0.6 per cent and 1.8 per cent of the province's hydro-electricity, but the storage for downstream power production is of great importance. This could be modified and drawdown limited to provide better recreational opportunities. Spray Reservoir provides a larger contribution to the electricity grid and drawdown should not be limited, except possibly in the peak summer demand period for recreational use. If Upper and Lower Kananaskis Lakes were to be kept at a constant summer level with hydro-electric power generation still present,

another upstream reservoir or interbasin transfer would be necessary. Any stabilisation of reservoir and river levels, or the guarantee of a minimum flow, would also enhance fishing opportunities in the Kananaskis Valley.

For recreation there exist numerous development possibilities. The access road to Spray Reservoir should be upgraded to a paved road and it is recommended that the road be continued (Plate 29) via Smith-Dorian Creek to connect with the paved Forestry Trunk Road at Kananaskis Lakes and extended via the Elbow Pass and the Elbow River Valley to Calgary. This road would provide additional opportunity for day-use recreation for residents of the Calgary area. In conjunction with this road, picnic tables, campsites and viewpoints should be installed. In Map 8 the capability for a campsite at Burstall and Mud Lakes is indicated. Viewpoints are also possible at this site and at the south-east corner of Spray Reservoir where there is the possibility of viewing the top of Mount Assiniboine. A recreation complex called Assiniboia has been proposed for the land at the southwest end of Spray Reservoir, (Alberta Environment Conservation Authority 1973) Such a development would be more feasible and permissible with this type of regional development. Upgrading of the road on the west side of Spray Reservoir to connect with a paved road from Banff through the Spray Valley should also be investigated.

The upland areas would be best zoned for extensive recreational use. In the Kananaskis Lakes area, trails to Hidden Lake, Aster Lake and Three Isle Lake are needed. At Spray Reservoir the trails to Marvel Lake and Mount Assiniboine Provincial Park need to be upgraded. If the use of this area is limited to extensive recreation activities, the zones will complement present national parks policy. Hunting should be permitted to continue in the Forest Reserve. A sustained yield of the resource is desirable. Skiing possibilities in the upland should be investigated, as the demand for this form of recreation is growing very rapidly. The Upper Kananaskis Valley and the area south-west of Spray Reservoir present interesting possibilities in this respect, as snowfall is relatively abundant here in comparison with areas farther north.

In the Elbow-Sheep drainage district greater use for recreation is desirable. More trails and picnic areas are needed. Snowmobile trails could replace hiking trails in winter. In other areas cross-country skiers in winter could use the summer hiking trails. Upgrading of some forestry roads may be considered desirable. Such a development would provide opportunity for the Calgary-based day use recreationist. In particular a road along the Elbow Valley through Elbow Pass and on to Kananaskis Lakes would cause

such a change in recreation use patterns.

Management for environmental protection and enhancement that would accompany these developments is complex. Physical measures involve the setting of objectives for watershed management. In particular, priorities exist for regime improvement in the Elbow drainage basin as waters from this basin contribute significantly to downstream flooding. In the front ranges future yield increases need to be protected. The control of fire needs to be considered in this respect.

In general physical and biological carrying capacity limits need to be established over the study area, to protect the environment. Other management problems involve the need for existing agencies to integrate resource uses. In this regard there is a need to establish objectives and priorities. From this, planning can take place and an integrated multi-use program put into effect.

Alternative Management Agencies for the Study Area

In chapter five it was shown how planning for the eastern slopes has been left to single-use oriented agencies. This is undesirable because management goals and objectives are limited and planning is not conducted in relation to other uses. In a plan for comprehensive multi-

use development two types of management agencies are possible to administer such a program. Either coordinating authorities could be encouraged or a new regional authority could be created. Coordinating authorities offer interesting possibilities. However provincial government departments have not coordinated development so far and it is reasonable to suppose they will not cooperate with each other in the future. Of greater possibility then, is the coordination between the existing regional planning commissions. Such management would stress regional needs and problems. The disadvantages are three-fold. Firstly the regions may become unwieldy. Secondly there is no guarantee that integrated resource planning would take place between the planning commissions, and thirdly more power would have to be vested in the planning commissions and yet this still would not ensure co-operation from provincial government agencies.

The second possibility is that a new regional authority could be created. Four disadvantages have been suggested: firstly it has been suggested that the integrity of provincial government departments would be lost by the creation of such an authority. Secondly the time required to establish such an agency would be an unnecessary delay in present planning. Thirdly it is thought that such a body would negate the usefulness of public hearings and fourthly the addition of more bureaucracy may be undesirable.

These criticisms are unjust. The integrity of provincial government departments has already been lost by their piecemeal fragmentation of land use planning. Secondly time already spent on a management plan is greatly in excess of that required to set up a new authority. Thirdly a new regional body need not ignore public hearings and fourthly the need for integrated resource planning is great and only a regional authority can adequately provide such planning.

In the national parks a strong body exists to implement management plans. An equally strong body is needed outside the parks. Only a new regional authority can provide such a measure of control. A new regional authority could promote integrated multiple use, encourage the development of management alternatives and provide a functional mix of private and public participation in resource use. Features which at present are lacking in the eastern slopes of Alberta.

<u>The Kananaskis Lakes Provincial Park</u>

In the spring of 1975 the Kananaskis Lakes area was identified as the site for a new provincial park. This will have a great impact on recreational participation in the Kananaskis Lakes area. Use of the area should be greater than the present. Additional facilities will be needed to

deal with this influx. In addition it is worth re-emphasizing the developments suggested earlier and to suggest other facilities that are possible.

First priority should be given to the installation of a new large structured campground to the east of Lower Kananaskis Lake. From the C.L.I. for Recreation it can be seen that the capability exists in this area. More data are needed before the capacity is suggested but analysis of data from chapter one would suggest there is a need for a site containing over 150 units. Access to the lake and campsite needs to be upgraded. A parking lot may also be necessary. This would be best sited between the campground and the lake. The borrow pits for the dams offer interesting prospects in this respect.

At the lakes stump clearance and boat launch facilities are needed. Private companies should be encouraged to provide boat hire on the lakes. More fishing could be encouraged by stocking.

In the upland the area could be reserved for extensive recreational pursuits. Trails would be the most developed form of access into this area. Thought should be given to an interpretive trail to Hidden Lake. Hunting may also be limited in the upland to provide better opportunity for wildlife viewing. With regard to either land uses,

recreation should be dominant with watershed co-dominant. All other uses should become subordinate.

There is immediate need for planning in this park. This includes the need for a better data base and a clearer definition of objectives. The data required include reference to visitor characteristics and to physical and biological carrying capacities. Once these are established, planning should continue, stressing possible alternatives in planning, and providing for re-examination after a program has been effectuated.

Chapter 8

CONCLUSION

From the research conducted for this study and the analysis of the data, some conclusions can be drawn. There is a growing demand for increased recreational land and water use. The selection of which land is to be used is in turn dependent upon other constraints such as access, management, land ownership, and other land uses.

These constraints will be briefly discussed. It is also worth reiterating the high recreational capability of most of the hydro-electric reservoirs under study. The observed disparity between the high recreational capability and the scant provision of recreation facilities and opportunities is also worthy of comment. A summary of general recreation land use needs at the hydro-electric power reservoirs is helpful in this respect. In addition, a further plea will be made for multiple land use, regional planning and a regional authority to implement these plans. In connection with this, a concluding comment will be made on the role of Calgary Power in the provision of greater recreational opportunities at the hydro-electric power reservoirs. To conclude the discussion, reference will be made to the need for further additions to the data base and to further stages in the

planning process.

A number of inadequacies have been observed in the provision of recreation at the reservoirs. While these inadequacies were less noticeable at the smaller and little used reservoirs, they were readily apparent at the more popular reservoirs. These deficiencies were shown by despoilment of the area, overcrowding of the limited facilities and destruction of the environment. Despoilment was particularly noticeable at Spray Reservoir and Kananaskis Lakes where refuse and garbage were strewn over much of the 'developed' area. Overcrowding was detected at Lake Minnewanka and to a lesser extent at Kananaskis Lakes and Bearspaw Reservoir. Destruction of the environment was particularly noticeable at Spray Reservoir campsites and Kananaskis Lakes. In the North Saskatchewan river basin the reservoirs are inadequately used for recreation. This is due in part to physical and legal access. This is also the case at Ghost and Barrier Reservoirs. Such a situation should be rectified.

There are four factors significant in explaining the present low status of recreational land use at the nine hydro-electric power reservoirs. These are:

1. Competition between land uses
2. Present land ownership
3. Access
4. Present management policies

Competition in land use has its greatest effect upon recreation development at the reservoirs outside Banff National Park and outside the Forest Reserves. Within the National Park, recreation is theoretically dominant and in the Forest Reserve conflict with other uses was seen as minimal. Agriculture and mining hold monopoly roles on land use around Ghost and Bearspaw Reservoirs and recreational use is inhibited. This is aided, as at all the reservoirs, by the reluctance of the Calgary Power Company to encourage recreation.

Calgary Power Company does not encourage recreation because recreational use of the reservoirs is partly competitive with their operation. For example, erosion of the reservoir banks could become a problem if recreation were encouraged and hence rip-rap might be required. Recreationists would constitute a nuisance in the operations at the reservoir; in particular greater recreational use would bring pressure upon the Company to institute water level control. Moreover provision for recreation was never stressed in the terms of agreement with the provincial government and as a result recreational use of the reservoirs was conveniently ignored.

At Ghost and Bearspaw Reservoirs private ownership of the adjoining lands limits recreational development. In the

Forest Reserve management by the provincial government is such that recreational development is piecemeal and uncoordinated. To aid in the provision of future recreation areas, land privately held outside the reserve should be expropriated and used for public recreation. This is especially pressing at Bearspaw Reservoir.

Access can be both a positive and negative tool in the management of recreational development. Gravel roads tend to discourage most recreational users whereas the paving of a road will normally result in an increase in recreational demand. Therefore road paving should be directly related to facility provision. This is not done at present and is a contributing cause of many of the present inadequacies in recreation land use at the reservoirs.

The fourth reason for the present inadequacies is the lack of management. Destruction and despoilment are occurring because of a lack of high standard recreation facilities and areas. Such a provision is a part of strong management. Overcrowding is a result of an excess of recreaticnists for the sites available. This can be solved by the provision of other facilities elsewhere or better planning at the site. At Lake Minnewanka the latter solution is the only solution possible for there is little evidence of complementary development outside the national parks.

Fortunately there is evidence that active planning is underway at the Lake Minnewanka site to prevent overcrowding in the national parks.

At the low use reservoirs there is still a potential for better recreational land use. At Brazeau facilities need to be upgraded. Paving of the road to Drayton Valley would make this more urgent. At Ghost and Bearspaw Reservoirs land ownership should be changed to make the area less exclusive. Control of subdivision or expropriation of land are possible means to accomplish this objective. At Barrier Reservoir greater recreational use could be provided by the installation of such facilities as picnic tables, a boat launch and a campsite.

In the Canada Land Inventory recreational capability classification, the high recreational capability of most of the reservoir sites is indicated. However the facilities for recreation are sadly lacking. This factor is entirely due to the factors outlined above. The Kananaskis Lakes area rates the highest in terms of area of high C.L.I. values. Spray Reservoir is second in importance, Lake Minnewanka is third, Lake Abraham is fourth (Table 5). Except for Lake Minnewanka there is a lack of recreation facilities at all hydro-electric reservoirs of Alberta.

If these inadequacies in available opportunities are to

be overcome, greater provision has to be made for recreaticnal land use. Eleven general proposals for the improvement of recreational land use are outlined:

1. More campgrounds are needed, especially at Kananaskis Lakes, Spray Reservoir, Lake Minnewanka and to a lesser extent on Brazeau Reservoir.

2. More picnic areas are needed. As recreation traffic using such facilities tends to be transitory, picnic sites should be located at all the reservoirs but detached from the major access roads. The C.L.I. for Recreation indicates suitable sites.

3. Boat launching facilities are needed on all reservoirs. This is not a pressing concern at Lake Minnewanka or Lower Kananaskis Lake but facilities here will need to be improved with increased recreational demand.

4. The major roads to all reservoirs should be paved. This is especially critical at Brazeau and Bearspaw Reservoir. Provision of new and upgraded minor roads should be investigated for use as day-use motoring routes.

5. Consideration should be given to the establishment of designated recreation areas. Such areas include provincial or national parks. Activities in great demand and that could be accommodated appear to be hiking, camping, picnicking and scenic viewing. In conjunction with this there is a need for zoning definition within the eastern slopes to stress multiple use of the area.

6. Development, at the local scale, should be as harmonious as possible with the natural environment. For campsites, this includes careful spacing of the units to ensure privacy, location near the water body and yet with good access to the highway. The most suitable locations for campsites are indicated in chapters four and five.

7. All tree stumps on the reservoirs' beaches should be removed. This is critical at Spray Reservoir, Upper and Lower Kananaskis Lake and Barrier Reservoir.

8. All reservoirs should be developed for some form of recreation activity. Zoning to avoid conflict between recreation activities and between the major land use categories is needed.

9. Where recreational development is intensive, clustered development should be encouraged. This is particularly necessary at Lake Minnewanka, Lake Abraham and at Upper and Lower Kananaskis Lake.

10. There should be a functional mix of public and privately operated facilities.

11. Harmony of land uses is vital. To this end a master management plan for the region as a whole is needed, in which a stress on multiple use development might be present.

To fulfill those proposals the only possible authority is a regional authority particularly for the region outside the national parks. Otherwise development may not occur and if it does it will tend to be piecemeal and fragmented.

The position of Calgary Power is somewhat anomalous when dealing with future resource management. Alberta is one of the few provinces in which a private company (Calgary Power) controls a public resource (water). This is acceptable if the private company is attuned to public needs and if the terms of agreement with the government are such that recreational use will be encouraged rather than discouraged. In the case of Calgary Power Company their policy has been single use and single means oriented - namely use almost entirely for hydro-electric power production by a strict, inflexible method of plant operation (White 1971). Their major concessions to date have been to provide a minimum flow in the Spray River for fishing and to provide supplementary irrigation water. These can be seen as

a direct response toward halting controversy over a single use policy.

A case could therefore be made for greater cognisance by Calgary Power of the need for recreation at the Provincial hydro-electric power reservoirs. At the present time the role of Calgary Power is minimal. Furthermore Calgary Power is happy to have subdivision of the shoreline for private use as this results in the least damage, the least cost and the least inconvenience. Suburban subdivision at Bearspaw and cottage development at Ghost and Kananaskis Lakes would therefore be considered tolerable recreational uses. For other recreation activities the company does not prohibit such uses, nor does it encourage them. In part this policy is acceptable, for it is the responsibility of the province to assist in public use of such lands. Direction for greater use must therefore come from the government. Such policies should stress the development of alternatives within a multi-use, multi-means, planning framework.

Experience elsewhere has shown that water-based recreation can be integrated with other water uses. For example in British Columbia, recreation is an accepted land-use on hydro-electric reservoirs (B.C. Hydro Eleventh Annual Report 1973). Moreover B.C. Hydro is administered as a private corporation. It is probable that with increasing

demand for resources the Alberta government will require that resource use changes will take place. This is in line with changing attitudes in most parts of the world in regard to private use of public resources.

The reason for this negligence concerning recreational use can be placed with the provincial government of Alberta. Not only do they permit such a situation but they encourage it with unique cost-sharing agreements on reservoir construction, unwieldy lease arrangements for the land uses related to the reservoirs and payment for the clearance of reservoirs they do not own or which they lease (Table 6).

In the future, the terms of agreement with Calgary Power will probably change to ensure greater public recreational use. In this regard it would be good public relations for Calgary Power to promote some of these inevitable changes. Strong resistance to change could result in increased public pressure for the establishment of a crown corporation.

Although the information contained in the thesis is of great value in the planning process there still remains an urgent need for recreation data. In particular there is a great need for research on the nature, preferences, prejudices and patterns of the recreation consumer. In particular data are needed on the precise numbers of users

of recreation facilities, their socio-economic status, their expenditures on recreation, their length of stay at the recreation areas, their place of origin and destinations, their attitudes and their perceptions. With such data, planning can have a much sounder base.

In addition to this research, there is a need for greater recognition and application of other studies on reservoir recreation. Such background research would provide a sounder rationale for the allocation of land and water resources. In particular the U.S.A. experience should be closely examined for a large body of theory has been built up there and much of it may be applicable to Canada. Classification is a useful tool in this respect. More particularly, the type of study pursued in the thesis and the classification developed could possibly serve as a model for comparative studies elsewhere. There is need for such studies in other provinces - eg. British Columbia, Saskatchewan and Manitoba where crown corporations are now responsible for most power site developments.

In regard to physical resources, more inventory data on vegetation, wildlife and soil resources are required. There is also a need for better climatic data and water temperature measurements for these seem to affect recreational participation. Research of this nature would

possibly aid in planning use of the hydro-electric power reservoirs for recreation.

In terms of recreational capability there would be merit in defining the sub-classes more closely with possibly the use of more sub-classes. Such a possibility is best explained by testing the C.L.I. classification.

In management, zoning procedures need to be established, carrying capacities laid down and the components of classification tested.

Upon development of a more complete data base, planning should proceed into stages 4 and 5 (Mcloughlin). This involves the evaluation of the course of action laid down in chapter six, the formulation of a plan and the implementation of the resultant policy measures.

The possible courses of action can be evaluated using such indicators as means available (with multiple means preferable), the costs incurred, the potential benefits and the consequences of the actions.

Evaluation, using the concept of multiple means has been developed to some extent in the discussion of the alternatives available in recreation planning. For example drawdown limitation could be accomplished by either limiting hydro-electric power drawdown, greater utilisation of

thermally generated electrical power, providing upstream storage or by inter-basin transfer. In this regard it is to be noted that physical enhancement of the environment is just as possible as degradation in any multiple means and multiple purpose project.

Most analyses of means available for a project operation have stressed physical means. There are also multiple management alternatives in which the resource is managed in different ways for different uses. Evaluation procedures in multiple means management have been greatly aided by the use of optimisation models which provide a 'best fit' solution for management requirements.

There is a need for cost-benefit studies to be conducted at the hydro-electric power reservoirs of Alberta. The studies should focus on the cost of providing recreation facilities and the benefits that accrue from these facilities. From these studies, a better rationale for the provision of recreation facilities, both public and private, can be obtained. In addition there is a need for a greater evaluation of the social and economic benefits derived from other land uses.

The consequences of action are best evaluated by field survey or by having a sufficient data base to predict consequences of development. In an analysis of this type

there is a large amount of subjectivity which can only be rectified by having a sounder data base and by developing rationally based alternatives as solutions. However the data base can never be complete and action should not be deferred so long in waiting for it that much useful employment of the resource will have been missed.

With evaluations of this kind it is possible to derive a management plan for the area under study. Measures to implement the plan are then taken, and a successful program of resource use is effectuated.

The objective in this thesis was to assess the potential of the hydro-electric power reservoirs of Alberta for accommodating recreational demand. It is concluded that this potential is significant. A wide range of administrative and management strategies might be employed to realise this potential. These range from further construction, through modification in project operations, to amendments to existing legislation. Such alternatives have been outlined in the thesis. From such analysis it has become apparent that more data are needed to draw up specific management plans and that for certain phases of the planning process more intensive studies are needed. With such additional information, more efficient use can be made of societies natural resources.

Plate 1. The Southern end of Lower Kananaskis Lake showing fishermen at an unofficial boat launch area.

Plate 2. Brazeau Reservoir looking west.

Plate 3. Shoreline clearance at Brazeau Reservoir.

Plate 4. Spray Reservoir looking south showing shoreland stumps.

Plate 5. Spray Reservoir looking north.

Plate 6. Bank erosion in till at Lake Abraham.

Plate 7. Lake Minnewanka. The Palliser Range, in the background, rises over 5000 feet above the Lake.

Plate 8. Mount Inglismaldie (9725 feet) on the shore of Lake Minnewanka.

Plate 9. Upper Kananaskis Lake looking west.

Plate 10. Barrier Lake with Barrier Mountain in the background.

Plate 11. Lower Kananaskis Lake looking south showing the elongated shape of the Lake.

Plate 12. The viewpoint at the northern end of Lake Abraham.

Plate 13. Bearspaw Reservoir, looking west, showing the steeply sloping backshore.

Plate 14. Bearspaw Reservoir looking east.

Plate 15. The Upland to the north of Ghost Reservoir. The Reservoir is in the background.

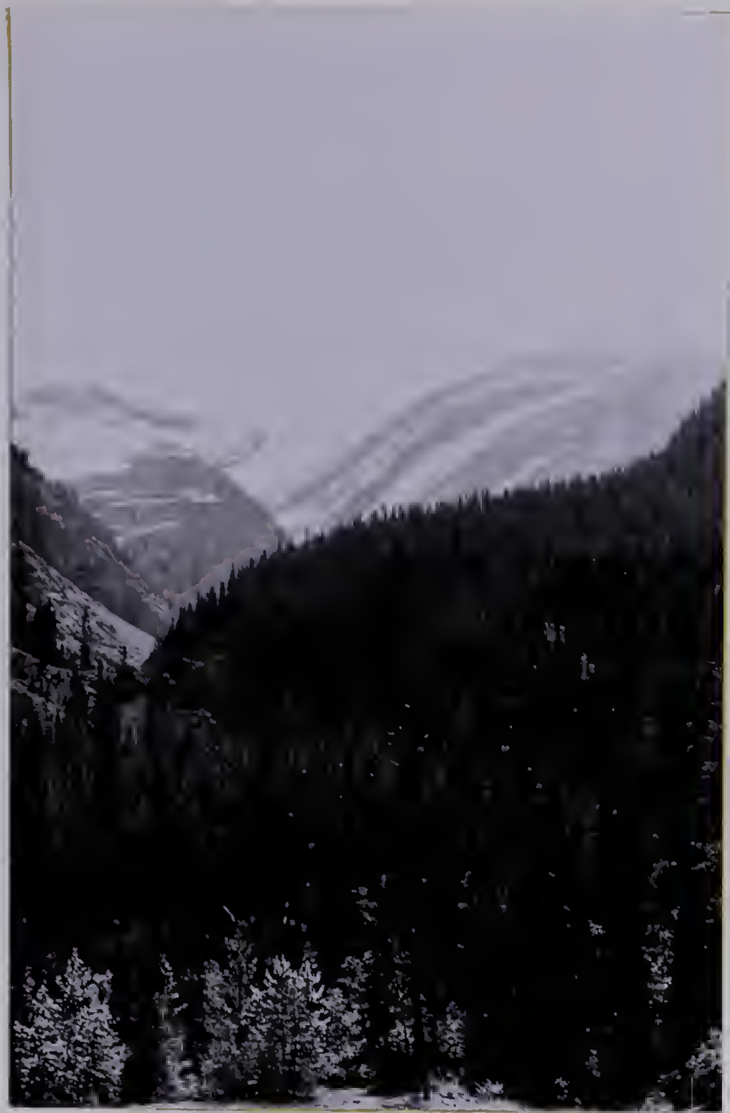


Plate 16. A Canyon on the shore of Lake Minnewanka.

Plate 17. Aylmer Canyon, Lake Minnewanka.

Plate 18. Ghost Village showing cottages and boat dock.

Plate 19. Ghost Village showing the exclusive nature of the cnly recreation area.

Plate 20. An unofficial campsite at Upper Kananaskis Lake showing environmental damage.

Plate 21. David Thompson Resort, Lake Abraham.

Plate 22. A viewpoint on the David Thompson Highway, Lake Abraham.

Plate 23. Unofficial camping and boat launching at the mouth of the Cline River, Lake Abraham.

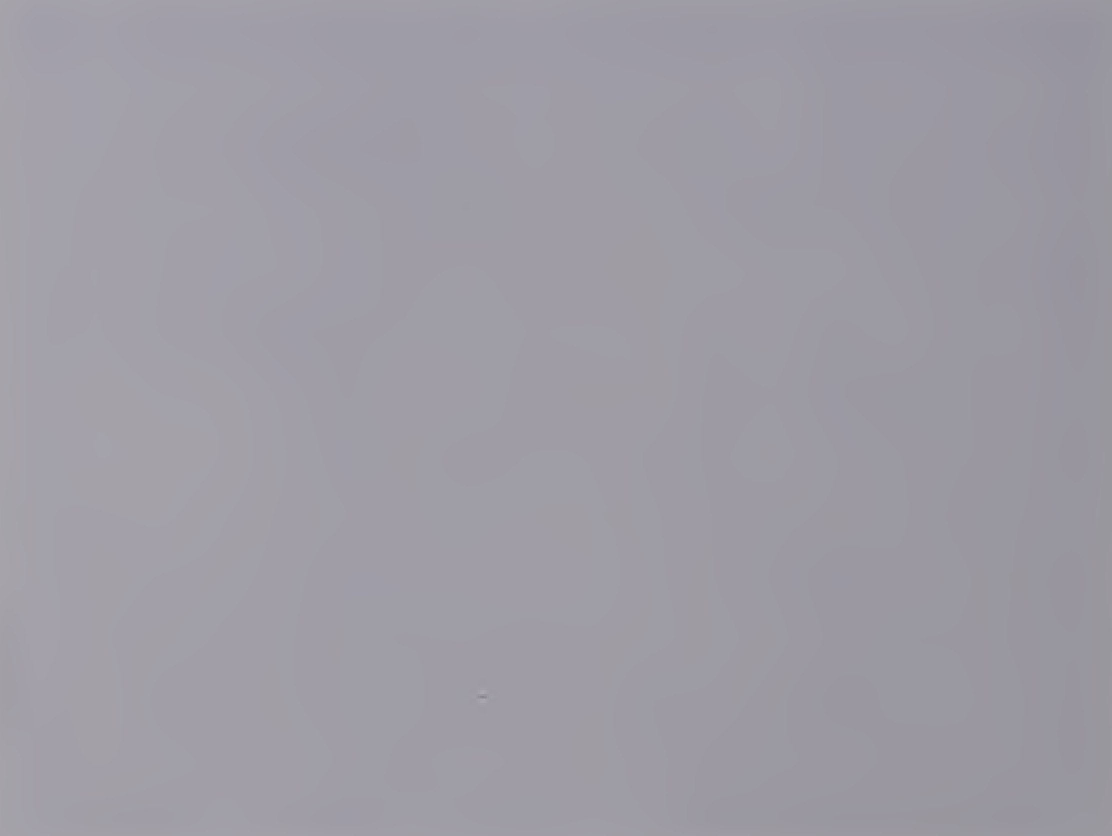


Plate 24. Lake Abraham and The David Thompson Highway, View from Windy Point looking west.

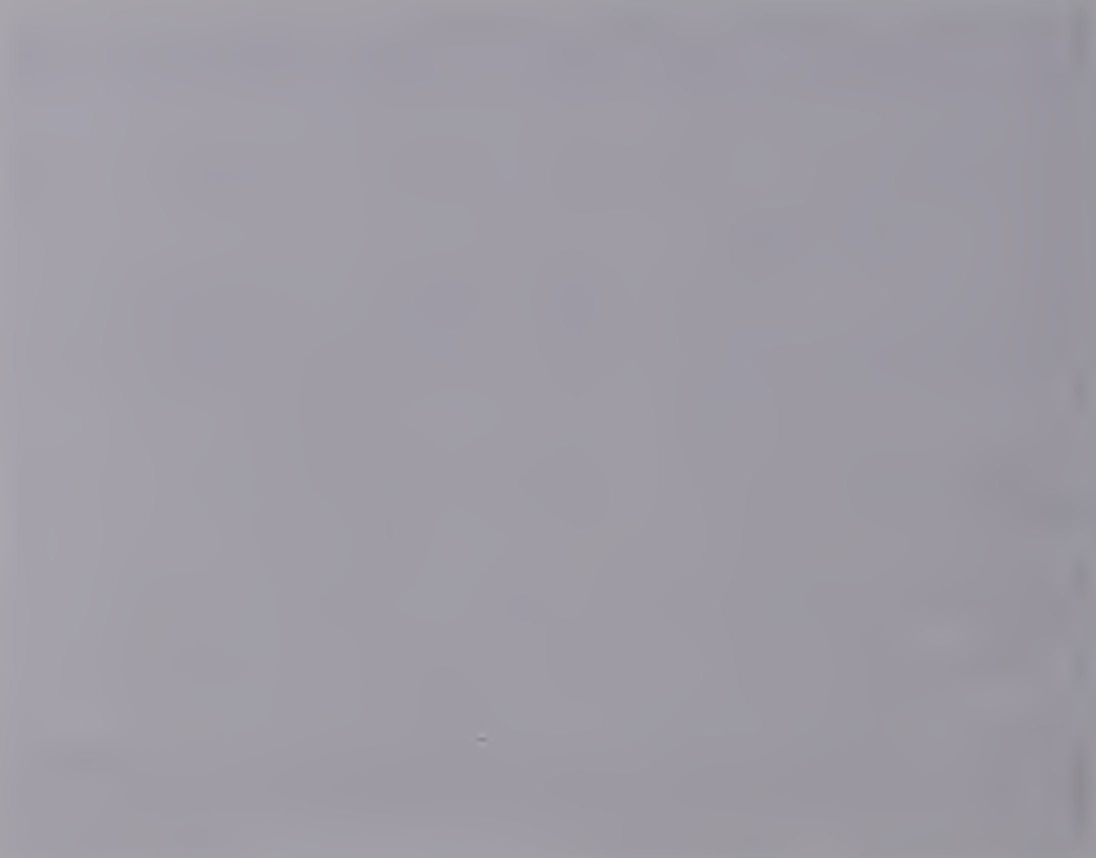
Plate 25. The boat dock at Lake Minnewanka.

Plate 26. Canoe hire and camping at Two Jack Lake.

Plate 27. Information sign and viewpoint looking east on the shore of Lake Minnewanka.

Plate 28. The unpaved Forestry Trunk Road, Kananaskis Valley, looking south.

Plate 29. Spray Reservoir looking west with the road to Lower Kananaskis Lake in the foreground and Mount Assiniboine in the background.



<u>Glossary of Terms</u>

Recreation - The positive use of leisure spent in a wide variety of pursuits.

Reservoir - Applied to waters held in storage in either artificial or natural basins

Yield - The quantity of water which can be taken, continously for any particular use. It is dependant on a surplus of precipitation over the evapotranspiration of the defined area.

Storage reservoir - In a storage reservoir water is impounded behind a dam and held for later use

Dam - A structure designed to hold back the flow of water.

Drawdown - The reduction in water level in a reservoir.

Eutrophication - The process by which nutrients needed for the growth of plants and animals accumulate in a standing water body.

Pondage - Regualtion of uniform flow or natural flow if there is no storage to suit variations in weekly local demand. A hydro-electric power plant is said to have sufficient pondage if the capacity of the pond above the intake is sufficient to take care of the hour to hour fluctuations of the load in the power plant throughout a period of one week.

Drainage basin - An area tributary to a particular stream and which is bounded by the drainage divides.

Watershed - Synonymous with <u>drainage basin</u>, although used more frequently with reference to small drainage basins and particularly to land-management units in the headwaters of a river.

Watershed Management - Administration and regulation of the aggregate resources of a drainage basin for the enhancement of yield or regime and or erosion, sediment or flood limitation according to defined objectives.

Management Plan - A plan for the orderly development, administration, and regulation of the aggregate resources of a defined area.

Management area - An area within which the development, administration and regulation of the aggregate resources will take place.

Multiple use - Is the use of natural areas or man made facilities which meet the space and facility requirements of several activities and which occur either at the same time or different times although it need not involve all uses in all areas at the same time.

Outdoor Education - The development of those skills and abilities that enable an individual to understand, appreciate and meaningfully utilize the environment.

Outdoor Recreation - Recreation that is undertaken outside of a confined physical structure

Planning - The process of detailing steps and priorities to reach short and long-range goals and objectives.

Facility - A physical structure and/or open space used for the operation of an activity

Wilderness - An area of undeveloped land retaining its primeval character and influence, possessing a low state of improvement or human influence and with the ability for the user to obtain a primative and unconfined type of recreation experience.

Wild land - Wilderness that is managed to preserve its natural condition and which is in a state of low development.

Public Recreation - Recreation that is available to all members of society and does not entail a user fee.

Recreation demand - The physical expression of the needs and wants of the recreationist. It is a function of the size, age, income level, mobility and present recreation consumption of the individual(s) and the available recreation opportunities.

Regime - The seasonal distribution of a river's flow.

Resource-based areas - Those areas and resources of such unusual and distructive quality that people are willing to travel large distances to visit them. Examples include national parks and federal wildlife refuges.

Intermediate use areas - A recreation area within a reasonable distance (perhaps one to two hours travel time) of most of its users and its physical characteristics although not always outstanding are sufficiently accessible that they are frequently used.

User-oriented areas - A recreational area located close to the user. The physical characteristic of the resource is secondary to the location factor.

Carrying capacity - The character of use that can be supported over a specified time by an area developed at a certain level without causing excessive damage to either the physical environment or the experience of the visitor.

Recreationist - One who takes part in a recreation activity.

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Appendix A. Recreation facilities at the Hydro-Electric Power Reservoirs of Alberta.

1. Project (Name) Bearspaw Reservoir

2. Stream (Name) Bow River

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Lethbridge, Red Deer

5. Owner of Development Calgary Power Ltd.

6. Reservoir
   - Water Surface (acres) 620 — Water depth 40.ft.
   - Shoreline (miles) 10.7 — Max. Water temp 60 deg.

7. Access by (Highway No.) 1A

8. Recreational facilities of reservoir
   - Access areas (number) None
   - Picnic areas (number, capacity) None
   - Camping areas (number, capacity) None
   - Recreational land (total acres)
     - Developed None
     - Undeveloped None
   - Lodges (number) None

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)
    - Fish pier or barge? X
    - Marina? X
    - Hiking? X
    - Riding trails? X
    - Wildlife refuge? X
    - Hunting area? X
    - Food depot, cafe, etc? X
    - Trailer park? X

11. Infrastructure
    - Is there parking space? (capacity) No
    - Piped water supply? No
    - Sewage and sanitary system? No
    - Electricity? No
    - Public transportation nearby? No

12. Any other special facility? (describe)
    Subdivision presently occurring on north and south shores. North shore 84 houses planned. South shore 54 acres being subdivided.

1. Project (Name) Ghost Reservoir

2. Stream (Name) Bow River

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Lethbridge, Banff.

5. Owner of Development Calgary Power Ltd.

6. Reservoir
   - Water Surface (acres) 2855 — Max. Water depth. 100 ft
   - Shoreline (miles) 20.39 — Max Water temp 50 deg

7. Access by (Highway No.) 1A

8. Recreational facilities of reservoir
   - Access areas (number) One
   - Picnic areas (number, capacity) Two (6)
   - Camping areas (number, capacity) None
   - Recreational land (total acres)
     - Developed 15
     - Undeveloped unknown
   - Lodges (number) 70 cottages (108 lots)

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)
    - Fish pier or barge? Yes
    - Marina? Yes
    - Hiking? No
    - Riding trails? No
    - Wildlife refuge? No
    - Hunting area? No
    - Food depot, cafe, etc? No
    - Trailer park? No

    All facilities Owned by Ghost Village Association.

11. Infrastructure
    - Is there parking space? (capacity) No
    - Piped water supply? Yes
    - Sewage and sanitary system? Yes
    - Electricity? Yes
    - Public transportation nearby? Yes

12. Any other special facility? (describe)
    All facilities private and access prohibited.

1. Project (Name) Barrier Reservoir

2. Stream (Name) Kananaskis River, (Bow River)

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Banff.

5. Owner of Development Provincial Govt of Alta. (leased by Calgary Power Ltd.)

6. Reservoir
   Water Surface (acres) 761 Max Water depth. 150 ft
   Shoreline (miles) 8.4 Max Water temp. 50 deg.

7. Access by (Highway No.) Forestry Trunk Road.

8. Recreational facilities of reservoir
   Access areas (number) None
   Picnic areas (number, capacity) None
   Camping areas (number, capacity) None
   Recreational land (total acres)
   Developed None
   Undeveloped None
   Lodges (number) None

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)
   Fish pier or barge? X
   Marina? X
   Hiking? X
   Riding trails? X
   Wildlife refuge? X
   Hunting area? Yes
   Food depot, cafe, etc? X
   Trailer park? X

11. Infrastructure
   Is there parking space? (capacity) No
   Piped water supply? No
   Sewage and sanitary system? No
   Electricity? No
   Public transportation nearby? No

12. Any other special facility? (describe) ________

1. Project (Name) Lower Kananaskis Lake

2. Stream (Name) Kananaskis River (Bow System)

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Banff

5. Owner of Development Provincial Govt of Alta (leased by Calgary Power Ltd.)

6. Reservoir
   - Water Surface (acres) 1585 — Max. Water depth. 70 ft
   - Shoreline (miles) 13.8 — Max Water temp. 45 deg.

7. Access by (Highway No.) Forestry Trunk Road.

8. Recreational facilities of reservoir
   - Access areas (number) Two
   - Picnic areas (number, capacity) 48 (152)
   - Camping areas (number, capacity) 40 (160)
   - Recreational land (total acres)
     - Developed 28
     - Undeveloped 50 approx
   - Lodges (number) 58 cottages (70 lots)

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)
    - Fish pier or barge? X
    - Marina? X
    - Hiking? Yes
    - Riding trails? Yes
    - Wildlife refuge? X
    - Hunting area? Yes
    - Food depot, cafe, ect? X
    - Trailer park? X

11. Infrastructure
    - Is there parking space? Yes(unofficial)
    - Piped water supply? Yes
    - Sewage and sanitary system? Yes Only to cottages.
    - Electricity? Yes
    - Public transportation nearby? No

12. Any other special facility? (describe)
    4 Boat launch areas
    8 Toilets(dry)
    1 Water Pump
    43 Tables

1. Project (Name) Upper Kananaskis Lake

2. Stream (Name) Kananaskis River (Bow System)

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Banff.

5. Owner of Development Provincial Govt of Alta (leased by Calgary Power Ltd.)

6. Reservoir

   Water Surface (acres) 2120 Max. Water depth. 150 ft.

   Shoreline (miles) 8.1 Max. Water temp. 42 deg.

7. Access by (Highway No.) Forestry Trunk Road.

8. Recreational facilities of reservoir

   Access areas (number) Two

   Picnic areas (number, capacity) One (4)

   Camping areas (number, capacity) Many unofficial

   Recreational land (total acres)

   Developed None

   Undeveloped 8

   Lodges (number) None

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)

    Fish pier or barge? X

    Marina? X

    Hiking? Yes

    Riding trails? Yes

    Wildlife refuge? X

    Hunting area? Yes

    Food depot, cafe, etc? X

    Trailer park? X

11. Infrastructure

    Is there parking space? (capacity) Yes(unofficial)

    Piped water supply? No

    Sewage and sanitary system? No

    Electricity? No

    Public transportation nearby? No

12. Any other special facility? (describe) One toilet (dry)

1. Project (Name) Spray Lakes Reservoir

2. Stream (Name) Spray River (Bow System)

3. Indicate: Planned as single-purpose hydro project multi-purpose project (with, without) recreation Single-purpose
4. Location (Name towns within 150 miles of over 2,500 population) Calgary, Banff
5. Owner of Development Provincial Govt of Alta. (leased by Calgary Power Ltd.)
6. Reservoir
   - Water Surface (acres) 4910 — Max. Water depth. 180 ft.
   - Shoreline (miles) 34.6 — Max. Water temp. 50 deg.
7. Access by (Highway No.) gravel road.

8. Recreational facilities of reservoir
   - Access areas (number) None
   - Picnic areas (number, capacity) None
   - Camping areas (number, capacity) 21 (84)
   - Recreational land (total acres)
     - Developed 20
     - Undeveloped Unknown
   - Lodges (number) None

9. Nearby Park (within 1/2 mile) Name Banff National Park on west side.
10. Does the reservoir have (check-yes, X-no)
    - Fish pier or barge? X
    - Marina? X
    - Hiking? Yes
    - Riding trails? X
    - Wildlife refuge? X
    - Hunting area? Yes
    - Food depot, cafe, etc? X
    - Trailer park? X

11. Infrastructure
    - Is there parking space? (capacity) Yes(unofficial)
    - Piped water supply? No
    - Sewage and sanitary system? No
    - Electricity? No
    - Public transportation nearby? No

12. Any other special facility? (describe)
    21 waste water Areas
    5 Toilets (dry)
    22 Stoves.

1. Project (Name) Lake Minnewanka

2. Stream (Name) Cascade (Bow System)

3. Indicate: Planned as single-purpose hydro project multi-purpose project (with, without) recreation Single-purpose

4. Location (Name towns within 150 miles of over 2,500 population)
Banff, Calgary. Golden (B.C.) Revelstoke (B.C.)

5. Owner of Development Federal Govt of Canada. (leased by Calgary Power Ltd.)

6. Reservoir
   Water Surface (acres) 5475 Max. Water depth. 300 ft.
   Shoreline (miles) 25.79 Max. Water temp. 48 deg.

7. Access by (Highway No,) No. 1

8. Recreational facilities of reservoir
   Access areas (number) One
   Picnic areas (number, capacity) 23 (92) (max. capacity 160)
   Camping areas (number, capacity) See Two Jack Lake
   Recreational land (total acres)
      Developed 12
      Undeveloped unknown, probably around 200 acres
   Lodges (number) None

9. Nearby Park (within 1/2 mile) Name Within Banff National Park.

10. Does the reservoir have (chec-yes, X-no)
   Fish pier or barge? Yes
   Marina? Yes
   Hiking? Yes
   Riding trails? No
   Wildlife refuge? Yes
   Hunting area? No
   Food depot, cafe, etc? Yes
   Trailer park? No

11. Infrastructure
   Is there parking space? (capacity) Yes (146 maximum)
   Piped water supply? Yes
   Sewage and sanitary system? Yes
   Electricity? Yes
   Public transportation nearby? No

12. Any other special facility? (describe)
   1 Boat launch for boat hire
   2 Scenic cruisers for hire
   6 Toilets (4 dry, 2 wet)

1. Project (Name) Two Jack Lake
   -Power canal for L. Minnewanka.
2. Stream (Name) Cascade, Bow System

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Single-purpose
4. Location (Name towns within 150 miles of over 2,500 population) Banff, Calgary.
5. Owner of Development Federal Govt of Canada.
   leased to Calgary Power Ltd.
6. Reservoir
   Water Surface (acres) 8 Max. Water depth. 20 ft.
   Shoreline (miles) 2.9 Max. Water temp. 48 deg.
7. Access by (Highway No.) No. 1

8. Recreational facilities of reservoir
   Access areas (number) Two
   Picnic areas (number, capacity) One (4 tables)
   Camping areas (number, capacity)
   Two-Lakeside: 79 units with 79 tables
   54 fireplaces
   12 toilets
   3 wash houses
   3 kitchens
   1 telephone
   Two Jack: 308 units with 380 tables
   380 fireplace
   76 toilets
   19 kitchens
   1 telephone
   1 theatre
   Recreational land (total acres)
   Developed 25
   Undeveloped 200
   Lodges (number) None

9. Nearby Park (within 1/2 mile) Name
   In National Park

10. Does the reservoir have (check-yes, X-no)
    Fish pier or barge? X
    Marina? X
    Hiking? Yes
    Riding trails? X
    Wildlife refuge? Yes
    Hunting area? No
    Food depot, cafe, etc? X
    Trailer park? Yes plus sanitary cleaning unit.

11. Infrastructure
    Is there parking space? (capacity) Yes(unknown)
    Piped water supply? Yes

Sewage and sanitary system? Yes
Electricity Yes
Public transportation nearby? No

12. Any other special facility? (describe)
20 Canoes for hire.
5 row boats for hire.
2 viewpoints
Power boats are prohibited

1. Project (Name) Lake Abraham (Big Horn Reservoir)

2. Stream (Name) North Saskatchewan River

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Multi-purpose without recreation)

4. Location (Name towns within 150 miles of over 2,500 population)

Red Deer.Rocky Mountain House, Lacombe,Olds.

5. Owner of Development Province of Alta. (leased by Calgary Power.)

6. Reservoir

   Water Surface (acres) 13760 Max. Water depth. 250 ft.

   Shoreline (miles) 42.54 Max. Water temp. 55 deg.

7. Access by (Highway No.) NO. 11

8. Recreational facilities of reservoir

   Access areas (number) None

   Picnic areas (number, capacity) One(36-9 tables)

   Camping areas (number, capacity)

   One(134 units) 28 with power
   32 with power, water, and sewer
   64 with no facilities

   Recreational land (total acres)

   Developed 15

   Undeveloped 30

   Lodges (number) 1 motel - 24 units

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)

   Fish pier or barge? X

   Marina? X

   Hiking? X

   Riding trails? X

   Wildlife refuge? X

   Hunting area? Yes

   Food depot, cafe, etc? Yes 1 restaurant, 1 service Station.

   Trailer park? X

11. Infrastructure

   Is there parking space? (capacity) Yes-30 cars

   Piped water supply? Yes for lodge

   Sewage and sanitary system? Yes

   Electricity? Yes

   Public transportation nearby? No

12. Any cther special facility? (describe)
 2 historical site markers
 1 Viewpoint.
 1 Diorama.

1. Project (Name) Brazeau Reservoir

2. Stream (Name) Brazeau River (North Saskatchewan System.)

3. Indicate: Planned as single-purpose hydro project, multi-purpose project (with, without) recreation Multi-purpose (without Recreation)
4. Location (Name towns within 150 miles of over 2,500 population) Edmonton, Red Deer. Drayton Valley, Hinton, Edson
5. Owner of Development Province of Alta and Calgary Power Ltd.
6. Reservoir
   Water Surface (acres) 11,200   Max. Water depth. 150 ft.
   Shoreline (miles) 76.13   Max. Water temp. 55 deg.
7. Access by (Highway No.) Gravel road

8. Recreational facilities of reservoir
   Access areas (number) One
   Picnic areas (number, capacity) Five (30)
   Camping areas (number, capacity) None
   Recreational land (total acres)
      Developed Two
      Undeveloped Unknown
   Lodges (number) None

9. Nearby Park (within 1/2 mile) Name None

10. Does the reservoir have (check-yes, X-no)
   Fish pier or barge? X
   Marina? X
   Hiking? X
   Riding trails? X
   Wildlife refuge? X
   Hunting area? X
   Food depot, cafe, etc? X
   Trailer park? X

11. Infrastructure
   Is there parking space? (capacity) Yes (unofficial)
   Piped water supply? No
   Sewage and sanitary system? No
   Electricity? No
   Public transportation nearby? No

12. Any other special facility? (describe)
   1 designated boat launch area
   2 Toilets (dry)
   50 Litter barrels

Appendix B. Recreational Use of the Hydro-Electric Power Reservoirs of Alberta.

Selected Statistics on the Use of Hydro Reservoirs for Recreation in Alberta.

Visitor Origin

Kananaskis Lakes (1967)

Calgary	= 68%
Edmonton	= 5%
B.C.	= 8%
Ontario	= 5%
U.S.A.	= 10%

Spray Lakes (1954)

Calgary	= 52%
Local	= 24%
Rest of Alberta	= 22%
U.S.A.	= 0.5%

Lake Minnewanka

day use zone

Alberta	= 74%
Other	= 26%

campgrounds

Alberta	= 37.8%
other Canada	= 22.2%
U.S.A.	= 40.0%

Lake Abraham Motel (1974)

Calgary	= 12%
Edmonton	= 21%
Red Deer	= 9%
Other Central Alberta	= 13%
Rest of Alberta	= 12%
Cut of Province	= 24%
Other Country	= 8%

Use Characteristics

Kananaskis Lakes - Activities
(1967)

Riding =	5.6%
Trails =	9.5%
Nature app. =	8.3%
Fishing =	16.5%
Swimming =	10.7%
Boating =	15.5%
Relaxation =	13%
Suntanning =	5.6%
Other =	12%

length of stay

Overnight =	16%
Day =	27%
2-Day =	27%
3-Day =	11%
1 Week =	16%

Lake Minnewanka

Use

Average No. of Cars in Parking	weekday = 46
Lot at 3:p.m. (1972)	weekend = 86
(Maximum capacity 150)	Sundays = 144

Most popular activities are fishing and sightseeing but the percentages are unknown.

Average daily traffic to
Lake Minnewanka: = 1550 cars (1971)

Lake Abraham Campground

Total campers 1974 = 680
Total Motel patrons 1974 = 1548

Average No. of cars per day.
David Thompson Highway No. 11 = 250

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